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TELEVISION AND CONSULTANT SERVICES AS METHODS OF INSERVICE EDUCATION FOR ELEMENTARY SCHOOL TEACHERS OF MATHEMATICS.

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THE PROBLEM OF THIS STUDY WAS TO DETERMINE THE RELATIVE EFFECTIVENESS OF TELEVISION, FACE-TO-FACE LECTURE-DISCUSSION, TELEVISION SUPPLEMENTED BY CLASSROOM CONSULTANT SERVICES, AND FACE-TO-FACE LECTURE-DISCUSSION SUPPLEMENTED BY CLASSROOM CONSULTANT SERVICES AS METHODS OF INSERVICE EDUCATION FOR ELEMENTARY SCHOOL MATHEMATICS TEACHERS. PRE- AND POST-TESTING WAS COMPLETED BY 89 TEACHERS. ASSIGNMENTS TO RESEARCH GROUPS WERE MADE ON THE BASIS OF THREE CRITERIA--(1) LOCATION OF THE TEACHER'S SCHOOL, (2) EXPERIENCE OF THE TEACHER, AND (3) SOCIOECONOMIC LEVEL OF THE SCHOOL COMMUNITY. PARTICIPANTS WERE ASSIGNED TO ONE OF TWO GROUPS--(1) A TELEVISION GROUP AND (2) A FACE-TO-FACE LECTURE-DISCUSSION GROUP. CONSULTANT SERVICES WERE MADE AVAILABLE TO APPROXIMATELY ONE-HALF OF THE PARTICIPANTS IN BOTH GROUPS. CHANGE IN ACHIEVEMENT OF TEACHERS, TEACHER REACTION TO THE INSERVICE EDUCATIONAL PROGRAM, CHANGE IN TEACHERS' CLASSROOM PRACTICES, AND CHANGE IN PUPILS' ACHIEVEMENT AND INTEREST IN MATHEMATICS WERE MEASURES USED IN DETERMINING THE RELATIVE EFFECTIVENESS OF THIS INSERVICE PROJECT. CONCLUSIONS WERE--(1) TELEVISED INSTRUCTION WAS AS EFFECTIVE AS FACE-TO-FACE LECTURE-DISCUSSIONS WITH RESPECT TO MEASURES USED IN EVALUATION AND (2) CONSULTANT SERVICES, SUPPLEMENTING TELEVISION AND FACE-TO-FACE LECTURE-DISCUSSION, MADE A SIGNIFICANT CONTRIBUTION IN SOME SITUATIONS. (HB)

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BUREAU OF LABORATORY SCHOOLS
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TELEVISION AND CONSULTANT SERVICES

AS METHODS OF IN-SERVICE EDUCATION FOR ELEMENTARY SCHOOL TEACHERS OF

MATHEMATICS

BY M. VERE DEVAULT

W. ROBERT HOUSTON AND CLAUDE C. BOYD

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Foreword

It is a pleasure to add this monograph to the Bureau of Laboratory Schools series. The monograph summarizes a distinctive research operation executed in a commendable manner and deals with important problems which have been of concern to many. During the time that the study was in progress Dr. De Vault was a member of the College of Education faculty at The University of Texas. His two associates were graduate students completing their Doctor's degrees under his tutelage. The authors hope that the publication of this report will clarify some doubtful issues and stimulate others to carry the research forward.

Henry J. Otto
Project Supervisor

October, 1961

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Preface

Television, in-service education, and elementary school mathematics represent three aspects of the current educational scene which are the focus of rather extensive research efforts. The study reported herein brought together the interests of the investigators in these three areas. Television was the primary basis for the research support made possible through Research Grant Number 7–41–070.00, Title VII, of the National Defense Education Act, 1958. The resources of Radio/Television, The University of Texas, were made available for the production of the videotapes and the investigators gratefully acknowledge the contributions of many Radio/Television staff members. Mr. Robert F. Schenkkan, Director, and Mr. Harvey Herbst, Program Director, effectively administered those aspects of the project related to television. Our thanks for excellent assistance throughout the production of the twenty-four videotapes are due Mr. C. Wesley Lambert, Television Studio Supervisor. We would like to bring our Writer-Producer, Mr. Hugh Greene, on stage for a special round of applause for his untiring efforts in successfully bringing together television, in-service education, and elementary school mathematics. Without his sensitivity to the problems of elementary school teachers of mathematics and without the creative manner in which he solved problems of content and production our efforts would have been mediocre indeed.

In-service education involves the cooperation of many people. We are grateful for the continuing relationship between the Division of Extension Teaching of The University of Texas and the administrative and supervisory staff of the Dallas Independent School District. We frequently called on Dr. A. C. Murphy, Director, Division of Extension Teaching, and Dr. Frank L. Williams, Dallas Assistant Superintendent in Charge of Instruction, for assistance which facilitated the administrative aspects of the project. To Mr. H. Garland Read, Consultant in Elementary Education, we express appreciation for help with both administrative and supervisory aspects of the study as they related directly to schools and to teachers. To the principals in sixty-two Dallas schools we owe thanks, but ultimately the great debt of gratitude goes to one hundred two teachers who gave of their time and energy in testing sessions, in school conferences, and in in-service education meetings throughout the school year. The manner in which they accepted and completed the responsibilities for which they had volunteered was an example of outstanding professional achievement.

Professors of mathematics are becoming increasingly aware of their responsibilities to elementary and secondary education. Cooperative efforts between mathematicians, professors of education, school administrators, and teachers are everywhere in evidence. We were most fortunate in having as our mathematician Dr. Roger Osborn of the Department of Mathematics, The University of Texas. Financed in part by a grant from the University Research Institute, Dr. Osborn served as television teacher and as lecturer in the lecture-discussion in-service meetings. In addition he assisted in the organization and preparation of written materials. The excellent manner in which he worked with elementary teachers in face-to-face situations, as well as by television, accounts to a large extent for the positive manner in which teachers reacted to the entire in-service education program.

The research design and techniques were reviewed early in their development by Dr. Henry J. Otto, Dr. Carson McGuire, both of the College of Education, and by Dr. Wayne Holtzman, Director of Research for the Hogg Foundation for Mental Health at The University of Texas. Their encouragement and assistance throughout the progress of the study was of much value. We are also indebted to Dr. Clifford Lunneborg and Dr. Paul Kelley for their excellent services as research and statistical consultants.

Several graduate students contributed significantly to the success of the research. Marillyn Kirkpatrick Odom was responsible for many aspects of the classroom practices portion of this study. A. Paul Wishart, Gail Shannon, Leo Bradley, Ann Robertson, and Anne Hardt were research associates on the project and effectively assisted in the development of instruments and in the collection of data.

Mr. George McBee assumed a major share of the responsibility for the statistical analysis of the data. Working through the Human Development Laboratory, he developed programs appropriate to our problems for use with the CDC 1604 computer. These programs for the analysis of covariance, correlation coefficients, and other statistical analyses are available through the Human Development Laboratory of The University of Texas.

The senior author, M. Vere DeVault, served as project director. W. Robert Houston, now at Michigan State University, and Claude C. Boyd, now with Indiana University in Pakistan, served as research associates in several capacities. They served as classroom consultants to half of the project teachers; they assumed a major part of the responsibility for testing teachers and children; and they completed dissertations related to aspects of the study.

September 1961

M.V.D.
W.R.H.
C.C.B.

CHAPTER I

The Nature of the Investigation

The extensive concern for promoting the continued education of teachers beyond the four-year college program promises to place increasingly greater demands on in-service education. The acceptance of this challenge is evidenced by the growing emphasis placed on extended in-service education programs. These programs have been organized in numerous ways utilizing a variety of methods including lectures, child-study programs, action research, television, discussion groups, and classroom consultant services. The effectiveness of these methods of in-service education has been evaluated only casually. Curtis,[1] Anderson,[2] Johnson,[3] and others have pointed out that an outstanding need in the field of education is a critical objective analysis of the effectiveness of particular techniques employed in the in-service education of teachers. Curtis[4] further noted that little research has been reported in this area other than that which has analyzed statements by which teachers have indicated their preferences.

The present study was designed to evaluate the relative effectiveness of television, face-to-face lecture-discussion, television supplemented by classroom consultant services, and face-to-face lecture-discussion supplemented by classroom consultant services, as methods of teacher in-service education. The relative effectiveness of these methods was evaluated in terms of changes in teacher understandings, changes in teacher classroom practices, and changes in pupil understandings.

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[1] Dwight K. Curtis, "Preservice and In-service Education of Elementary- and Secondary-School Teachers," *Review of Educational Research*, XXVIII (June, 1958), p. 217.

[2] Robert H. Anderson, "The Influence of In-service Improvement Program Upon Teacher Test Behavior and Classroom Practices," *Journal of Educational Research*, XLIV (November, 1950), p. 213.

[3] Loaz W. Johnson, "County In-service Education Programs in California," *Educational Research Bulletin*, XXVI (September, 1947), pp. 156–60.

[4] Curtis, *loc. cit.*

Formulation of the Hypotheses of the Study

Television and Face-to-Face Lecture-Discussion as Media in In-Service Education

The use of educational television offers a challenging possibility for improving teacher competencies in in-service education. Television facilities are presently or potentially available to most areas in the United States. In 1952, the Federal Communications Commission assigned television channels to 242 (now 257) American communities for educational use. With the establishment of station KERA-TV, Dallas became the forty-eighth community to provide open-circuit television facilities for educational purposes.[6] In addition, more than 200 closed-circuit television installations are in use throughout the country, wth scores of others presently being planned.[7]

In-service education programs have been presented through television by numerous educational agencies. Minneapolis,[8] New York,[9] Evanston,[10] St. Louis, Philadelphia, Dade County, Florida,[11] and Houston[12] are but a few of the public school systems utilizing television in the in-service education of professional personnel. State universities, too, have coordinated area in-service education programs presented via television. During 1957–1958, the University of North Carolina offered a series of in-service education programs. Faculties within a range of 80 miles viewed each telecast, then participated in discussions led by the local principal.[13]

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[5] Harold E. Wigren, "ETV: The Story Up to Now," *NAEB Journal*, XVIII (May, 1959), p. 3.

[6] Area Educational Television Foundation, Inc., *KERA-TV Channel 13* (Dallas, Tex.: Area Educational Television Foundation, Inc., n.d.), p. 2.

[7] Edwin P. Adkins (ed.), *Television in Teacher Education* (Washington, D. C.: The American Association of Colleges for Teacher Education, 1960), p. 20.

[8] Clarissa Sunde, "Teachers Meet Via TV," *NAEB Journal*, XVII (March, 1958), pp. 6–8, 24–26.

[9] Fred M. Hechinger, "Opening of New Term Will Bring Innovations in Many Areas," *The New York Times*, August 21, 1960, p. E9.

[10] National Association of Secondary-School Principals, *Staff Utilization Studies* (Urbana, Illinois: National Association of Secondary-School Principals, n.d.), p. 6.

[11] Donald G. Tarbet, *Teacher In-service Education by Television* (Chapel Hill: University of North Carolina, 1958), pp. 7–9.

[12] Alexander Frazier, "Television and In-service Education," *The High School Journal*, XLIV (November, 1960), pp. 73–78.

[13] Donald G. Tarbet, "In-service Teacher Television," *The American School Board Journal*, CXXXVI (June, 1958), pp. 31–32.

During the 1958–1959 school year, the facilities of a statewide network of commercial stations were made available to the Texas Education Agency so that teachers might study the need for curriculum change and development. Actively participating in the series were more than 30,000 teachers, school administrators, and lay citizens throughout the state who viewed the programs, then got together in meetings to discuss the implications of the program and how the ideas expressed could be used to improve instruction in the local community.[14] "Continental Classroom," a nationwide series of programs designed to increase teachers' understanding of physics, chemistry, and mathematics, is now in its third year. Jointly sponsoring the venture with the National Broadcasting Company are the American Association of Colleges for Teacher Education, the Ford Foundation, and the Fund for the Advancement of Education. In addition, several corporations have provided substantial financial support.[15]

Although programs of in-service education by television have been numerous, there are no research studies reported which have investigated the relative effectiveness of these methods when compared with other methods of in-service education. The full potential of this medium is not likely to be realized without such experimentation and thorough study.[16]

However, numerous studies have investigated the relative effectiveness of television and regular methods of instruction in college extension courses, college campus courses, and in the United States Armed Forces. The findings of these studies have implications for the use of television in the in-service education of instructional personnel.

Benedict[17] studied the relative effectiveness of television and regular classroom procedures in presenting an extension course in audio-visual methods. Based on final examination test scores, no statistically significant differences were found between the two groups. He concluded that instruction by television was as effective as instruction by conventional methods.[18] The findings of both Husband[19] and Stromberg[20] support this conclusion.

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[14] Texas Education Agency, *Teacher-Recruitment and Education Through Television* (Austin, Tex.: Texas Education Agency, 1959), p. 21.

[15] Hope Chamberlain, "Continental Classroom Progress Report," *NAEB Journal*, XIX (September–October, 1960), pp. 33–37.

[16] Department of Audio-Visual Instruction, National Education Association, *Proceedings of the NEA Leadership Seminar on the Role of Television in Instruction* (Washington, D. C.: Department of Audio-Visual Instruction, National Education Association, 1958), p. 96.

[17] Joel Avery Benedict, "The Development of an In-service Training Program in Audio-Visual Methods Through Television" (unpublished Ed.D. dissertation, Stanford University, 1959).

Considerable research has been conducted with educational television in universities and colleges. Some of the most comprehensive series of studies have been conducted at Pensylvania State University where more than thirty comparisons have been made between televised and direct instruction. In all these studies the same teachers have taught comparable groups by the two methods. The results of these studies consistently show no significant difference in student achievement between televised and direct instruction.[21] Pennsylvania State University's conclusions have been confirmed by experiments in many other colleges around the country. In such diverse courses as English,[22] typewriting,[23] psychology,[24] physics,[25] slide rule,[26] and mathematics,[27] research studies revealed no difference in pupil achievement as measured by final examination scores. Erickson and Chausow[28] found no significant differences between conventionally taught and TV taught students in nine courses at Chicago Junior College. These findings were not confirmed in studies at Miami University (Ohio), which suggested that a course in introductory economics might not be suitable for television, possibly because of the abstract nature of the material.[29] Seibert[30] concluded, after evaluating a course in English Composition, that conventional instruction was more effective than televised instruction. The preponderance of evidence cited in the studies above, however, has indicated that the two methods of instruction are comparable in changing achievement.

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[18] *Ibid.*, p. 47.

[19] Richard W. Husband, "Television Versus Classroom for Learning General Psychology," *American Psychologist*, IX (May, 1954), pp. 181–83.

[20] Eleroy L. Stromberg, "College Credit for Television Home Study," *American Psychologist*, VII (August, 1952), pp. 507–509.

[21] C. R. Carpenter, L. P. Greenhill, and Others, *An Investigation of Closed-Circuit Television for Teaching University Courses*, Report No. 1 (University Park, Pa.: Pennsylvania State University, 1955). C. R. Carpenter, L. P. Greenhill, and Others, *An Investigation of Closed-Circuit Television for Teaching University Courses*, Report No. 2 (University Park, Pa.: Pennsylvania State University, 1958). L. P. Greenhill, "Research on Televised Instruction at the Pennsylvania State University," *College Teaching by Television* (Washington, D. C.: American Council on Education, 1958), pp. 75–76.

[22] William E. Buckler, "A College English Teacher Looks at Television: Composition," *The Journal of Educational Sociology*, XXXI (May, 1958), pp. 346–52.

[23] William R. Pasewark, *Teaching Typewriting Through Television* (East Lansing, Mich.: Bureau of Business Research, Michigan State University, 1956).

[24] Richard I. Evans and Others, "An Evaluation of the Effectiveness of Instructions and Audience Reaction to Programming an Educational Television Station," *Journal of Applied Psychology*, XXIX (August, 1955), pp. 277–79.

[25] Warren F. Seibert, *A Brief Report and Evaluation of Closed-Circuit Television Instruction in Physics 230–240* (Lafayette, Ind.: Purdue University, 1957).

[26] Oakley J. Gordon, E. C. Nordquist, and D. M. Engar, "Teaching the Use of the Slide Rule Via Television," cited in "NAEB Research Fact Sheets," Series 1: No. 78, *NAEB Journal*, XVIII (November, 1959).

[27] Warren F. Seibert, *An Evaluation of Televised Instruction in College Freshman Mathematics* (Lafayette, Ind.: Purdue University, 1958).

Pioneer research studies in the effectiveness of television as a method of instruction have been conducted by the United States Armed Forces. Television was found to be as effective as face-to-face methods of instruction in a series of studies conducted by Kanner and Associates[31] and Rock and Others.[32]

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[28] Clifford G. Erickson and Hymen M. Chausow, *Report on the First Year, 1956–57: The Chicago City Junior College Experiment in Offering Regular College Courses for Credit Via Television* (Chicago: Chicago City Junior College, 1957).

[29] Ford Foundation, and The Fund for the Advancement of Education, *Teaching by Television* (New York: Ford Foundation, 1959), p. 22.

[30] Warren F. Seibert, *An Evaluation of Televised Instruction in College English Composition* (Lafayette, Ind.: Purdue University, 1958).

[31] Joseph H. Kanner, R. P. Runyon, and Otello Desiderato, *Television in Army Training: Evaluation of Television in Army Basic Training*, Technical Report 14 (Washington, D. C.: Human Resources Research Office, George Washington University, 1954).

Joseph H. Kanner, R. P. Runyon, and Otello Desiderato, "Television as a Training and Educational Medium," *Audio-Visual Communication Review*, III (Summer, 1955), pp. 163–72.

Richard P. Runyon, Otello Desiderato, and J. H. Kanner, "Factors Leading to Effective Television Instruction," *Audio-Visual Communication Review*, III (Fall, 1955), pp. 264–73.

Otello Desiderato, J. H. Kanner, and R. P. Runyon, "Procedures for Improving Television Instruction," *Audio-Visual Communication Review*, IV (Winter, 1956), pp. 57–63.

Joseph H. Kanner, "Future Trends in Television Teaching and Research," *Audio-Visual Communication Review*, V (Summer, 1957), pp. 513–27.

[32] Robert T. Rock, Jr., James S. Duva, and J. E. Murray, *Training by Television: Comparative Effectiveness of Instruction by Television, Television Recordings, and Conventional Classroom Procedures* (Port Washington, L. I., N. Y.: Special Devices Center, U. S. Department of the Navy, n.d.).

Holmes[33] made a rather involved but comprehensive classification system by means of which previous educational television research was correlated and analyzed. He concluded that almost ninety per cent of the comparisons between television and conventional communication conditions show no substantial differences in achievement or information gain.

Hypothesis Number One. Based on the findings of the studies reviewed thus far in this chapter, the following hypothesis was formulated and tested in the present study.

> There is no difference in the effectiveness of television and face-to-face lecture-discussion as media for in-service education of intermediate grade teachers of mathematics.

The need for interaction. One of the factors which may limit the effectiveness of television as a method of in-service education is the lack of interaction between the instructor (or instructor team) and the teacher. Guba noted that there are three levels of academic learning.[34] At the *action* level the student on his own initiative teaches himself through suitable material. The second is the *reaction* level in which the student learns by reacting to the instruction of a teacher. The *interaction* level is attained when the student learns by interaction with the teacher and other learners.

Television, as a method of instruction, has been utilized primarily at the reaction level. Several groups of communication specialists and educators have been concerned with the lack of interaction in television instruction.[35] Several notable attempts have been made to supplement the televised instruction with activities designed to bring about interaction. Kanner[36] asked Army trainees to write down materials, to call out correct answers, and to perform manipulations during the televised program.

Robert T. Rock, Jr., James S. Duva, and J. E. Murray, *Training by Television: A Study in Learning and Retention* (Port Washington, L. I., N. Y.: Special Devices Center, U. S. Department of the Navy, n.d.).

[33] Presley D. Holmes, Jr., *Television Research in the Teaching-Learning Process* (Detroit, Mich.: Division of Broadcasting, Wayne State University, 1959).

[34] Egon G. Guba, "Evaluation and the Airborne Television Project," *Educational Research Bulletin,* XXXIX (October, 1960), pp. 184–85.

[35] *Ibid.*

Finette P. Foshay, *Interaction in Learning: Implications for Television,* A report of a seminar held at NEA headquarters January 31–February 3, 1959 (Washington, D. C.: Division of Audio-Visual Instruction Service, National Education Association, 1959).

[36] Kanner, Runyon, and Desiderato, *loc. cit.,* p. 167.

Interrupting a program after posing a question or outlining a concept was tried in Houston, Texas.[37] The viewers were instructed to form buzz groups and discuss the subject while a sign on the screen said "Back in 10 Minutes." Some institutions have utilized discussion groups of varying sizes, using graduate students, younger professors, and school principals as discussion leaders.[38] Experiments have been undertaken with two-way "talk-back" sound systems at the State University of Iowa, Pennsylvania State University, and the State College of Washington.[39] At Pennsylvania State University it was found that such a system did not bring about increased achievement on the part of students.[40] Case Institute of Technology has developed two-way television, so that the instructor can both see and hear his students.[41]

Consultant Services in In-Service Education

In the in-service education of teachers, one of the promising possibilities for providing interaction is the classroom consultant, working directly with teachers as individuals and in small groups. Fawcett[42] pointed out the need for personal contact in this day of mass communication. Can educational television or large group lectures to teachers in service provide the time necessary for personal relations between the in-service education consultant and the classroom teacher? Further, will the educational consultant, working with individual teachers and small groups, bring about improved understanding and performance by the teacher?

The term "educational consultant" first appeared in *The Education Index*[43] in 1948 and has since been increasingly prevalent in the literature of education. There can be little doubt that "consultant service," broadly conceived, has become standard practice as a means of attacking school problems in virtually every area of education. Savage[44] indicated that services of this nature have been offered by state departments of education and professional schools of education for many years. James and Weber[45] concluded that, as a rule, these services are inaugurated as a means of increasing the effectiveness of the on-going operation. Consultant services have been utilized in areas such as finance,[46] building and grounds,[47] public relations,[48] curriculum construction and reorganization,[49] improvement of instruction,[50] and others. Adams[51] reported that consultant service was listed as the most desired service by Kentucky school superintendents in 1949. In a cooperative program of in-service education at Southern Illinois University consultant services were made available to a school staff in the belief that the practice had promise for improving the school's program and in promoting the professional growth of personnel.[52]

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[37] Foshay, *loc. cit.*, p. 39.

[38] Ford Foundation, and the Fund for the Advancement of Education, *op. cit.*, pp. 17, 19.

Tarbet, *loc. cit.*

James E. Cochrane, "Closed-Circuit TV Experiment in Teacher Education, State University College of Education, Albany, New York," *AACTE Bulletin*, XII (January, 1960), p. 5.

[39] Ford Foundation, and The Fund for the Advancement of Education, *loc. cit.*, p. 19.

[40] L. P. Greenhill, C. R. Carpenter, and W. S. Ray, "Further Studies of the Use of Television for University Teaching," *Audio-Visual Communication Review*, IV (Summer, 1956), pp. 200–215.

[41] Ford Foundation, and the Fund for the Advancement of Education, *loc. cit.*

[42] Novice G. Fawcett, "TV and Higher Education," *NAEB Journal*, XVIII (October, 1958), pp. 7–10, 33–38.

[43] Dorothy Ross Carpenter (ed.), *The Education Index*, VII (New York: H. W. Wilson, 1950), pp. 467, 642.

Research specifically designed to determine the actual effectiveness of consultant services as such has not been reported. Indeed, it would be difficult, if not impossible, to investigate consultant services as a method of in-service education without first more clearly delineating the specific consultant role under consideration. The term has come to have a variety of connotations. School systems have in recent years begun to designate the special subject-matter specialist and general supervisors as "consultants";[13] state departments of education also use the term for certain staff members;[14] local and state organizations so designate persons brought in for specific work-conferences or an individual meeting;[15] many universities and colleges engaged in cooperative research projects use the term to designate their field workers.[16] Blaha[17] uses the term only when referring to those individuals who are not on a regular schedule of visitation or assignment. He indicates that the term might be further defined to include only those individuals serving a school system "on call" or especially selected to assist in the identification and solution of problems. Little[18] supports this definition by using "consultant" to refer to any person whose counsel is sought in connection with an educational problem. Lawler[19] defines the term even more explicitly when she uses it only in reference to persons who come from outside the school to work with the faculty over a period of time.

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[44] William W. Savage, *Educational Consultants and Their Work in Midwestern State Departments of Education* (Chicago: The Midwest Administration Center Cooperative Program in Educational Administration, University of Chicago, 1952), p. 72.

[45] Edward W. James and Robert A. Weber, *School Consultants: Roles Assumed and Techniques Employed* (Austin, Tex.: The Southwestern Co-operative Program in Educational Administration, The University of Texas, 1955), pp. 1–14.

[46] W. C. Reavis, "Place of the Consultant; School Administrator Needs the Expert for Special Problems," *The Nation's Schools*, XLI (April, 1948), p. 24.

[47] W. A. Whitehead, "Educational Consultant Service in Planning School Buildings," *Educational Research Bulletin*, XXVI (October, 1947), pp. 179–85.

N. L. Engelhardt, "Work of the Educational Consultant in School Surveys and Building Planning," *American School and University*, 1957, pp. 54–62.

[48] Reavis, *loc. cit.*

[49] W. K. Dunton, "Role of the Consultant in Vocational and Industrial Arts Planning," *Industrial Arts and Vocational Education*, XLIX (March, 1960), pp. 73–74.

[50] M. E. Dawley and R. McLaughlin, "Role of the Music Consultant," *National Elementary School Principal*, XXXIX (December, 1959), pp. 20–22.

[51] Harold P. Adams, *An Approach to the Development of a Program of In-Service Education for Public School Superintendents in Kentucky*, XXII (Lexington, Ky.: Bureau of School Service, College of Education, University of Kentucky, (December, 1949), p. 95.

[52] Woodson W. Fishback, "Improving Instruction Through Consultant Services," *Educational Administration and Supervision*, XLIII (October, 1957), pp. 373–76.

In the present study the consultant was a person from outside the school system who worked with teachers as individuals and in small groups to supplement more formal presentations via television or face-to-face lecture discussion. It is appropriate, in view of the purposes of this study, to give further consideration to specific activities of the consultant which would appear to promote interaction when used in conjunction with other in-service methods.

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[13] J. M. Atkin, "Needed: Elementary School Science Consultants," *Science Teacher*, XXIV (October, 1957), pp. 270–72.

[14] William W. Savage, "State's Educational Consultant," *State Government*, XXV (November, 1952), pp. 252–55.

[15] James and Weber, *loc. cit.*, p. 4.

[16] John I. Goodlad, "The Consultant and In-Service Education," *In-Service Education for Teachers, Supervisors and Administrators*, Fifty-sixth Yearbook of the National Society for the Study of Education, Part I (Chicago, Ill.: University of Chicago Press, 1957), p. 174.

[17] Marion J. Blaha, "When and How a Consultant Can Be Used Most Effectively," *Educational Leadership*, X (November, 1952), p. 96.

[18] W. W. Little, "Making the Consultant's Service Serve," *Educational Administration and Supervision*, XXXVIII (December, 1952), pp. 480–85.

[19] Marcella R. Lawler, "Role of the Consultant in Curriculum Improvement," *Educational Leadership*, VIII (January, 1951), p. 221.

In Indianapolis, for example, Tower[60] reported from a survey of teachers, principals, and consultants that the individual conference with consultants was rated most helpful by all groups as an in-service procedure. This survey also indicated that regular consultant help and group meetings on common problems were rated among the most helpful procedures used in in-service education. Gappa and Van Meter[61] listed small group meetings, classroom visits, conferences with principals and consultants, and demonstrations among the most helpful in-service procedures. Lerner[62] also found small group discussions among the most successful activities in helping teachers with previous specialized training in their work with mentally retarded children in state institutions in the United States and Canada. Downing[63] reported on the use of consultant services in the five states of Virginia, Delaware, Maryland, North Carolina, and South Carolina. She concluded that the techniques most frequently used by educational consultants in that area were: (1) demonstration, (2) lecture, (3) group discussion, and (4) individual conference. Specific techniques and combinations of techniques considered most effective by the largest number of individuals were: (1) demonstration and group discussion, (2) group discussion, and (3) demonstration.

Reports of the use of consultants in an improvement program in Kingsport, Tennessee,[64] indicated that consultants were used to visit classrooms, to hold individual and group conferences, and to work intensively with small groups of teachers in their own particular subject area. Evaluation of the program showed that all concerned were satisfied with the progress and that the program should be continued. Kinnick[65] reported on a study of in-service education in the Minnehaha Elementary School of Minneapolis in which careful records and intense evaluation indicated that better attitudes of children toward working with numbers and their increased appreciation of the importance of mathematics were apparent. Although consultant services were only a part of the total in-service activities of the Minneapolis program, it is probable that some of the success of the overall program could be attributed directly to consultant services. Numerous resource persons were used for talks to the teacher group as a whole, and when feelings of insecurity were detected among teachers, arrangements were made to have a consultant spend time in the school giving demonstrations in all grade levels. It was felt that these demonstrations helped to build teachers' confidence as they attempted to implement some of the newer ways of teaching being advocated in the in-service program.

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[60] Melvin M. Tower, "A Study of Orientation and In-Service Education Practices in the Indianapolis Public Schools," *Educational Administration and Supervision*, XLII (April, 1956), p. 220.

[61] Dan Gappa and Margaret Van Meter, "Opinions of Teachers Concerning the Most Helpful Supervisory Procedures," *Educational Administration and Supervision*, XLIII (April, 1957), p. 218.

[62] Joseph S. Learner, "Recommended Techniques for In-Service Education of Teachers for Mentally Retarded Children in State Institutions," *American Journal of Mental Deficiency*, LXII (November, 1957), p. 477.

[63] Mary Riggan Downing, "A Study of Certain Factors Involved in the Effective Utilization of the Services of Educational Consultants" (unpublished Ed.D. dissertation, University of Virginia, 1954).

[64] Fishback, *loc. cit.*, p. 373.

[65] Jo Kinnick, "The Teachers and the In-Service Education Program," *In-Service Education for Teachers, Supervisors, and Administrators*, Fifty-sixth Yearbook of the National Society for the Study of Education, Part I (Chicago, Ill.: University of Chicago Press, 1957), p. 136.

In summary, investigations into the use of consultant services have indicated that evaluations of administrators, supervisors, consultants, and classroom teachers indicate that certain activities of classroom consultants were thought to be effective. Among those rated highest are demonstration, individual conference, small group discussion, and combinations of these techniques. There has been much subjective evidence that these activities have been effective in promoting teacher improvement in service. However, research studies utilizing objective evidence to evaluate consultant services have not been reported. Therefore, further investigation into the effectiveness of classroom consultant services in connection with other forms of in-service education seems to be warranted.

Hypothesis Number Two. This study proposed to test the following hypothesis with regard to the effectiveness of classroom consultant service as a supplement to the media of television or face-to-face lecture-discussion in in-service education. For research purposes, the null form of the hypothesis was tested.

> There is no difference in the effectiveness of in-service education programs presented by television or face-to-face lecture-discussion which are supplemented with consultant services as compared to those in-service education programs without such consultant services.

THE PROBLEM

Broadly stated, the problem of this study was to determine the relative effectiveness of selected teacher in-service education methods. The hypotheses tested and questions which gave direction to the organization and completion of this study follow.

Hypothesis Number One

There is no difference in the effectiveness of television and face-to-face lecture-discussion as media for in-service education of intermediate grade teachers of mathematics.

Questions to be answered in testing the hypothesis include:

1. What is the relative effectiveness of television and face-to-face lecture-discussion as media of in-service education in changing the mathematics understanding of teachers?
2. What is the relative effectiveness of television and face-to-face lecture-discussion as media of in-service education in changing teachers' understanding of selected aspects of mathematics teaching method?
3. What is the relative effectiveness of television and face-to-face lecture-discussion as methods of in-service education as determined by teachers' reactions to the in-service education program?
4. What is the relative effectiveness of television and face-to-face lecture-discussion methods of in-service education in changing the classroom practices of teachers?
5. What is the relative effectiveness of television and face-to-face lecture-discussion methods of in-service education in changing the mathematics achievement of pupils of participating teachers?
6. What is the relative effectiveness of television and face-to-face lecture-discussion methods of in-service education in changing the mathematics interests of pupils of participating teachers?

Hypothesis Number Two

There is no difference in the effectiveness of in-service education programs presented by television or face-to-face lecture-discussion which are supplemented with consultant services as compared to those in-service education programs without such consultant services.

Questions to be answered in testing the hypothesis include:

1. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the mathematics understandings of teachers?
2. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing teachers' understandings of selected aspects of mathematics teaching method?
3. Are consultant services as a supplement to television or face-to-face lecture-discussion effective as determined by teachers' reactions to the in-service education program?

4. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the classroom practices of teachers?
5. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the mathematics achievement of pupils of participating teachers?
6. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the interests of pupils of participating teachers?

Related Questions of the Study

Questions of the study in addition to those which were specifically related to the hypotheses of the study include:

1. What is the relationship of change in teacher achievement to teacher actuarial and personality variables?
2. What is the relationship of teacher reaction to the in-service education program to change in teacher achievement and teacher actuarial and personality variables?
3. What is the relationship of change in teachers' classroom practices to teacher actuarial and personality variables, teacher reaction to the in-service education program, and change in teacher achievement?
4. What is the relationship of change in pupils' understanding of and interest in mathematics to teacher actuarial and personality variables, teacher reaction to the in-service education program, change in teacher achievement, and change in teachers' classroom practices?
5. To what extent does the effectiveness of the in-service education program differ among fourth, fifth, and sixth grade pupils?
6. To what extent does the effectiveness of the in-service education program differ among pupils in heterogeneous and in high achievement classes?

THE RESEARCH DESIGN

To test the two major hypotheses of the study and for the evaluation of data relative to most of the related problems, an experimental research design was utilized. The following independent variables were included.

A. *In-Service Presentation Media*—Television versus face-to-face lecture-discussion
B. *Consultant*—Yes or no
C. *Grade Level*—Four, five, or six
D. *Class Achievement Grouping*—High achievement grouped classes versus heterogeneously grouped classes

In that portion of the study concerned with teachers' understandings, Chapter III, only the first two independent variables were used inasmuch as individual teachers taught both types of classes (D) and at a number of different grade levels (C). In the chapters concerned with teachers' classroom practices and with pupils' achievement and interest, Chapters IV and V, research was relative to a specific class the teacher taught and thus all independent variables were included in the analyses of data.

Dependent variables used to test the relative effectiveness of the four methods of in-service education were of three varieties. First, change in teacher understandings of mathematics and of methods of teaching mathematics was measured with the use of three tests selected or designed for use in this study. Second, change in classroom practices of teachers was measured through the use of an interview technique involving six pupils from the teacher's classroom. Third, change in pupil understanding of mathematics and of interest in mathematics was measured with instruments selected and developed for use in this study. Thus, changes in the understandings of both teachers and pupils and the bridge which links the two—classroom practices—were used as dependent variables with which the four methods of in-service education were evaluated.

The analysis of covariance statistical technique was utilized in the analysis of the data relative to the effectiveness of the various in-service methods. This technique permitted evaluation of the relative change made by teachers and by pupils during the in-service education program. Pearson product-moment correlations were used in the relationship analyses reported in the study.

CHAPTER II

Procedures of the Study

SELECTION AND ASSIGNMENT PROCEDURES

Selection of the Study Site

In considering a site for the research study, the investigators were faced with two possibilities. The first was that of utilizing two communities and two school systems while the second was that of conducting the study in one system. Each alternative had certain advantages and disadvantages, and a number of factors were considered in making the final selection of the site for the study.

The use of two communities and two school systems would have allowed the investigators to employ a different media of presentation (television or face-to-face lecture-discussion) in each of two systems. This would have assured a minimum of contamination between the two primary experimental groups. This approach would also have vastly increased the possible choices of school systems by reducing the size requirement. On the other hand, the use of two communities would have introduced the problem of accounting for differences between school systems. Likewise, it would have doubled the number of central administrative staffs from which to acquire commitment and cooperation, and the problem of securing adequate local control of the research groups would have been magnified.

The second possibility, that of utilizing one school system, was deemed more appropriate for the present study. This decision was made because the use of one school system eliminated differences attributable to varying practices between school districts. The decision to utilize a single school system in the study necessitated finding one which met the following criteria:

1. Sufficient size to provide an adequate number of intermediate grade teachers of mathematics and their classes for use in the study
2. Sufficient means to provide for the control of contamination between experimental groups
3. Readily available open-circuit television facilities with videotape equipment

4. Willingness of professional personnel to participate in the study
5. Accessibility of the study site to the investigators

After considering several school systems, Dallas Independent School District was chosen as the site for the study. In addition to meeting the necessary criteria, Dallas offered the added advantage of the recently opened educational television station, KERA-TV, Channel 13. These facilities permitted the scheduling of television programs on school afternoons at the most convenient time. Adequate facilities for the face-to-face lecture-discussion sessions were also readily accessible.

The fourth, fifth, and sixth grades of the Dallas schools were organized on a platoon system.[66] The school day in most of the elementary schools was divided into thirteen half-hour periods with a few schools organized into fourteen shorter periods. Each subject area was usually taught one or more periods by a special teacher. The mathematics period was one hour in the fourth, fifth, and sixth grades. At each grade level, the pupils with the highest over-all achievement were placed in a special "high achievement" section, while all other students were randomly assigned to "heterogeneous" sections.

Selection and Assignment of the Study Population

During the spring and fall of 1960, teachers of intermediate grade mathematics in Dallas were given the opportunity to volunteer for an in-service education program to be conducted during the 1960–61 school year. Of approximately four hundred fifty teachers of intermediate grade mathematics in the Dallas Independent School District, one hundred two volunteered. Since most of these teachers taught several classes of mathematics, one class was selected by the investigators for inclusion in the statistical analysis of this study.

Assignment criteria utilized. Assignments to research groups were made on the basis of three criteria: (1) location of the teacher's school, (2) experience of the teacher, and (3) socio-economic level of the school community.

(1) Location of school. The assignment of teachers to television or face-to-face lecture-discussion sessions was determined by the first assignment criterion, that of location of the school. This was done in order that the lecture-discussion center might be as convenient as possible for the

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[66] For a more complete description of the Dallas platoon system, see Dallas Independent School District, *The Curriculum in Action: A Statement of Curriculum Organization* (Dallas, Tex.: Dallas Independent School District, 1951).

teachers assigned to that group. The lecture-discussion sessions were held in a junior high school which was centrally located and easily accessible to many teachers. These facilities had been used for similar purposes in the past and were known to teachers. Participants in the in-service education program taught in sixty-two elementary schools in widely scattered sections of Dallas. Because of the size of Dallas and the driving time required for some teachers to reach this location, those teachers nearest the site of the lecture-discussion sessions were assigned to this section. Other teachers were assigned to the television group of the in-service education series.

(2) Teaching experience. The second assignment criterion was teaching experience. Studies by both Steinbrook[67] and Barnes and Associates[68] indicated that length of teaching experience appeared to be associated with success in teaching. An analysis of the pilot project of this study[69] indicated that teachers with more experience reacted more favorably toward face-to-face lecture-discussion in-service education sessions while less experienced teachers preferred television. Teacher experience was therefore controlled in the placement of teachers and their classes in research groups in order to assure comparability of results in terms of this criterion. Teachers were ranked in terms of years teaching experience and the distribution thus obtained was divided into four quarters. The first quarter included teachers with from 1–5 years teaching experience, the second quarter with 5–10 years experience, the third quarter with 10–21 years experience, and the fourth quater included teachers with from 21–41 years experience.

(3) Socio-economic level of school community. The third assignment criterion was socio-economic level of the school community. After reviewing several studies regarding both individual and group achievement, Dodson concluded that social status is highly related to pupils' school

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[67] Roy S. Steinbrook, "Study of Some Differences in Background, Attitude, Experience and Professional Preparation of Selected Elementary Teachers with Contrasting Local Success Record" (unpublished Ed.D. dissertation, Indiana University, 1955).

[68] Kenneth Barnes, Raymond Cruickshank, and James Foster, "Selected Educational and Experience Factors and Arithmetic Teaching," *The Arithmetic Teacher*, VII (December, 1960), pp. 418–20, 430–31.

[69] W. Robert Houston, Claude C. Boyd, and M. Vere DeVault, "An In-Service Mathematics Education Program for Intermediate Grade Teachers," *The Arithmetic Teacher*, VIII (February, 1961), pp. 65–68.

achievement.[70] The socio-economic level of each school community in the study was appraised by an official in the central administrative offices of the Dallas schools who was familiar with the neighborhoods of all Dallas schools. His ratings were substantiated by a jury of three elementary education consultants who were familiar with these school districts. A rating of "one" was assigned the school districts with the highest socio-economic standing in the city while "four" was assigned to those school communities with the lowest socio-economic level.

Assignment of teachers. Each of the initial one hundred two teachers and their classes was assigned to one of the twenty-four groups established by the independent variables of the research design. The three assignment criteria (location of school, teaching experience, and socio-economic level of the school community) were considered in the placement of teachers. Research groups were balanced in terms of these

TABLE 1

Distribution of One Hundred Two Teachers and Their Classes Initially Assigned to the Study

In-Service Presentation Media (P)	Grade (G)	Class Achievement Grouping (A)	Consultant (C)		Total
			Yes	No	
Television	4	High Achievement	4	5	
		Heterogeneous	5	3	
	5	High Achievement	4	4	
		Heterogeneous	4	6	
	6	High Achievement	4	5	
		Heterogeneous	5	4	
Sub-Total			26	27	53
Face-to-Face Lecture-Discussion	4	High Achievement	4	4	
		Heterogeneous	4	4	
	5	High Achievement	4	4	
		Heterogeneous	4	3	
	6	High Achievement	4	4	
		Heterogeneous	5	5	
Sub-Total			25	24	49
Total			51	51	102

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[70] Dan W. Dodson, "Educational Sociology," *Encyclopedia of Educational Research, Third Edition* (New York: Macmillan, 1960), p. 409.

criteria. The number of teachers and their classes initially assigned to each research group is shown in Table 1. Of the one hundred two teachers who were initial participants in the in-service education program, two discontinued participation for personal reasons, and eleven others were dropped from the study as a result of unavoidable administrative changes in teaching assignment at mid-term. The remaining eighty-nine teachers and their classes constitute the population of the study. This distribution by research groups is presented in Table 2. Henceforth, all descriptions and analyses will be made relative to these eighty-nine teachers and their classes.

TABLE 2

Distribution of Eighty-Nine Teachers and Their Classes Utilized in the Study.

In-Service Presentation Media (P)	Grade (G)	Class Achievement Grouping (A)	Consultant (C)		Total
			Yes	No	
Television	4	High Achievement	4	5	
		Heterogeneous	3	3	
	5	High Achievement	4	4	
		Heterogeneous	3	5	
	6	High Achievement	4	5	
		Heterogeneous	5	4	
Sub-Total			23	26	49
Face-to-Face Lecture-Discussion	4	High Achievement	2	3	
		Heterogeneous	2	3	
	5	High Achievement	4	4	
		Heterogeneous	3	2	
	6	High Achievement	4	4	
		Heterogeneous	5	4	
Sub-Total			20	20	40
Total			43	46	89

THE IN-SERVICE EDUCATION PROGRAM

Delevopment of Content and Materials

During the spring and summer of 1960, the content and materials for the mathematics in-service education series were developed by a team from The University of Texas composed of Dr. Roger Osborn, Assistant Professor of Mathematics, and the authors, all members of the Department of Curriculum and Instruction. A pilot project to evaluate selected aspects of these materials and methods was undertaken. A series of five weekly in-service education sessions was presented for 252 Austin, Texas, teachers. Both closed-circuit television and lectures were used as media in the sessions. In addition, each participant received printed materials supplementing the oral presentations. Descriptions[71] and an evaluation[72] of the pilot project have been reported elsewhere. The basic ideas and concepts of the series were then arranged in twenty-one sections and provided for all teachers.[73] Thirteen sections pertained to significant concepts of mathematics; three presented aspects of the historical development of mathematics; and five sections dealt with the relationship between mathematics and selected areas in general education today. The titles and basic concepts stressed in each section are included in Appendix A. This content was subsequently revised for use in twenty-four half-hour television programs and twelve lectures.

Methods Utilized in the In-Service Education Program

The Dallas mathematics in-service education program was conducted during the 1960–1961 school year. The eighty-nine teachers included in this study participated in the program via four selected in-service education methods (television, television with consultant services, face-to-face lecture-discussion, and face-to-face lecture-discussion with consultant services).

Television. Forty-nine of these teachers received instruction via a series of twenty-four half-hour television programs. From the basic content developed for the series, television scripts were written by Hugh Greene, Writer-Producer for Radio/Television, The University of Texas. Dr. Osborn was the instructor for the series. Programs were produced in the studios of Radio/Television and recorded on videotape. Hours of rehearsal time, services of a commercial artist, close-up camera shots, and specially made props contributed to compact, carefully conceived presentations.

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[71] Roger Osborn and M. Vere DeVault, "A Mathematics In-Service Education Project for Elementary School Teachers," *The American Mathematics Monthly*, LXVII (November, 1960), pp. 914–15.

Hugh Greene, "Project: Mathematics—Videotape Teaches Teachers," *NAEB Journal*, XX (March, 1961), pp. 45–50.

[72] W. Robert Houston, Claude C. Boyd, and M. Vere DeVault, *loc. cit.*

[73] M. Vere DeVault, Roger Osborn, C. C. Boyd, and W. R. Houston, *Toward Improved Understanding of Mathematics*, Parts I and II (Austin, Tex.: Division of Extension, The University of Texas, 1960).

The programs were telecast every Tuesday that school was in session, beginning on October 18, 1960, and terminating April 4, 1961. The series was presented from 4:00 to 4:30 p.m. over educational channel KERA-TV, an open-circuit VHF station broadcasting on Channel 13. A schedule including broadcasting dates and program titles is presented in Table 3.

TABLE 3

Schedule of Twenty-Four Thirty-Minute Television Programs in the Mathematics In-Service Education Series

Number	Program Title	Written Materials Section Number*	Date Televised
1	Introduction	....	October 18, 1960
2	Numbers and Numerals	I	October 25, 1960
3	Base and Place	II	November 1, 1960
4	Some Properties of Arithmetic	III	November 8, 1960
5	Classroom Applications	I–III	November 15, 1960
6	The Fundamental Processes: Addition	IV	November 22, 1960
7	The Fundamental Processes: Multiplication	V	November 29, 1960
8	The Fundamental Processes: Subtraction and Division	VI	December 6, 1960
9	Common Fractions	VII	December 13, 1960
10	Decimal Fractions	IX	December 20, 1960
11	The Structure of the Number System	VIII	January 3, 1961
12	Classroom Applications	IV–IX	January 10, 1961
13	Systems of Numeration	X	January 17, 1961
14	The Development of the Units of Measure	XIII	January 24, 1961
15	Exploding Universe of Mathematics	XI	January 31, 1961
16	Creators of Mathematics	XII	February 7, 1961
17	Concepts of Measurement	XIV	February 14, 1961
18	Algebra	XV	February 21, 1961
19	Geometry	XVI	February 28, 1961
20	Statistics	XVII	March 7, 1961
21	Mathematics and the Fine Arts	XVIII	March 14, 1961
22	Shooting for the Stars	XIX	March 21, 1961
23	Physics and Chemistry	XX	March 28, 1961
24	Mathematics and Other Sciences	XXI	April 4, 1961

* See Appendix A for a listing of the basic concepts developed.

Face-to-face lecture-discussion. Forty teachers in the study participated in twelve one-and-one-half-hour face-to-face lecture-discussion sessions. These sessions were scheduled every other Tuesday afternoon from 4:30 to 6:00 p.m. The same professor of mathematics who presented the television series was the instructor. The same basic content as was presented by television was used in the face-to-face lecture-discussion series. In the face-to-face lecture-discussion sessions, the instructor encouraged participants to ask questions, raise issues, and clarify points during the presentations. A schedule of the dates and program content of each of these sessions is presented in Table 4.

TABLE 4

Schedule of Twelve One-and-One-Half-Hour Face-To-Face Lecture-Discussion Sessions in the Mathematics In-Service Education Series

Number	Program Title	Written Materials Section Number[b]	Date
1	Introduction Numbers and Numerals	I	October 24, 1960
2	Base and Place Some Properties of Arithmetic	II, III	November 8, 1960
3	The Fundamental Processes: Addition The Fundamental Processes: Multiplication	IV, V	November 22, 1960
4	The Fundamental Processes: Subtraction and Division Common Fractions	VI, VII	December 6, 1960
5	The Structure of the Number System	VIII	December 20, 1960
6	Decimal Fractions Systems of Numeration	IX, X	January 10, 1961
7	Systems of Numeration Exploding Universe of Mathematics	X, XI	January 24, 1961
8	Creators of Mathematics The Development of the Units of Measure	XII, XIII	February 7, 1961
9	Concepts of Measurement Algebra	XIV, XV	February 21, 1961
10	Geometry Statistics	XVI, XVII	March 7, 1961
11	Mathematics and the Fine Arts Shooting for the Stars	XVIII, XIX	March 21, 1961
12	Physics and Chemistry Mathematics and Other Sciences	XX, XXI	April 4, 1961

[b] See Appendix A for a listing of the basic concepts developed.

The following action was taken to control the viewing of the open-circuit television series. First, teachers were informed of the research aspects of the in-service education program as a part of the initial lecture-discussion session. It was pointed out that neither they nor their pupils should view any of the television programs, and their professional cooperation was enlisted to maintain this control. Second, the television series was scheduled at the time when teachers attending the lecture-discussion series were traveling to their in-service meeting. Thus, for one-half of the television programs, these teachers would not be able to view the series. Being scheduled immediately after school, pupils, too, were either on their way home or were attending an after-school recreation program. Third, the very nature of the series (with its content designed for teachers) precluded most of the pupils in the study from being interested in watching the series.

Classroom consultant services. The services of a classroom consultant were made available to approximately half of the teachers (twenty-three) viewing the television presentations and to half of the teachers (twenty) attending the face-to-face lecture-discussion sessions. Two consultants[74] spent twenty-four days each, for a total of forty-eight days, working with these teachers as individuals and in small groups.

The role of the consultants was to assist the classroom teacher in finding effective ways of relating new ideas in mathematics to actual classroom instructional procedures. In designing consultant services, it was determined that the classroom consultant would base his services on the expressed needs of individual teachers rather than on any artificial balancing of time, services, content, or mode of operation. Thus, the consultants were resource persons who assisted with problems *teachers* considered to be important. The services of the consultants included assistance in (1) analyzing instructional problems, (2) developing activities or programs leading to the possible solution of identified problems, and (3) clarifying new concepts presented in the in-service education series.

Qualifications of the two consultants were similar in that each had approximately ten years experience as elementary school teacher and administrator; each had supervised student teachers while on the staff of The University of Texas; and each had served as a consultant in mathematics to other school systems throughout the State of Texas. In addition to these kinds of experiences, both consultants were members of the team responsible for the selection and organization of the content for this in-service education program.

Consultant-served teachers taught in twenty-seven different schools, with from one to six participating teachers in each school. To expedite the consultant services, these teachers were divided into two groups on the basis of geographical location of the school in which they were teaching.

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[74] Classroom consultants were Claude C. Boyd and W. Robert Houston.

The mean number of consultant visits per teacher was 5.21 with a range of from four to six visits for each teacher. Thirty-one teachers were visited five times; thirteen were visited six times; and four were visited four times. The mean amount of time spent with each teacher was five hours. Information relative to the mean frequency and amount of time spent with the total television and face-to-face lecture-discussion groups is presented in Table 5.

TABLE 5

Amount of Consultant Time and Frequency of Visits for Forty-Three Teachers by In-Service Consultant Groups

Consultant Group	Number of Teachers	Visits		Time in Hours	
		Number	Mean	Number	Mean
Television-Face-to-Face Consultant	23	125	5.44	125.25	5.45
Lecture-Discussion-Consultant	20	99	4.95	91.91	4.60
Total	43	224	5.21	217.16	5.05

It is pertinent to note in Table 5 that while the mean number of consultant visits for the total group was 5.21, the means for television and face-to-face lecture-discussion groups were 5.44 and 4.95 respectively. Likewise, the mean amount of time for each teacher in the television group was greater by .85 hours.

The modes of operation of the consultants also varied considerably from teacher to teacher as the consultant sought to meet the expressed needs of individuals. Attempts were made to utilize modes of operation which had been recommended in the literature. Among these were individual conferences, small group discussions, classroom visitations, and classroom demonstrations. Data relative to the frequency with which these modes of operation were employed with the television and face-to-face lecture-discussion groups are presented in Table 6. The tendency for the television group to utilize more consultant services is consistently evident in the relatively larger mean frequency of each mode of operation as presented in Table 6.

TABLE 6

Consultant Services Utilized by Forty-Three Teachers in the Television-Consultant and Face-to-Face Lecture-Discussion-Consultant Groups

		Mode of Operation							
		Classroom Observation		Classroom Demonstration		Individual Conference		Small Group Discussion	
In-Service Group	N	Frequency	Mean	Frequency	Mean	Frequency	Mean	Frequency	Mean
Television-Consultant	23	65	2.82	4	1.91	105	4.57	32	1.40
Face-to-Face Lecture-Discussion-Consultant	20	41	2.05	34	1.70	87	4.35	13	.65
Total	43	106	2.47	78	1.81	192	4.47	55	1.28

Correlation coefficients of various aspects of consultant service to teacher change in mathematics achievement, pupil change in mathematics achievement and interest, selected teacher actuarial and personality variables, teacher reaction to the in-service program, and classroom practices are presented in Appendix B. Although these relationships are of considerable interest, they are beyond the primary scope of the present study. Nonetheless, it should be noted that teacher change in understanding of mathematics was significantly related to total time spent with the consultant and the number of small group discussions held by the consultant. Even though consultant services were related directly to teachers, and consultants worked with none of the *tested* classes, pupil change in mathematics understanding was significantly related to the number of classroom observations and demonstrations made by the consultant. These consultant services, planned to meet the expressed needs of teachers, were used significantly more by teachers of little experience than by those of much experience. Personality factors were not related to the consultant variables. Teachers with whom consultants spent the greatest amount of time reacted more favorably than others to the in-service program in general and to the usefulness of the content of the program. General reactions were also related to the number of small group discussions held by consultants; reaction to the media was related to the number of classroom observations made; and the reaction to the usefulness of the material was significantly related to the number of classroom demonstrations held by the consultant.

DESCRIPTION OF THE TEACHER POPULATION

Actuarial Data

Early in September a registration form entitled *Teacher Background Information* was distributed to all teachers of arithmetic in grades four, five, and six in the Dallas Independent School District who had expressed an interest in participating in the in-service education program and research project during the 1960–1961 school year. Completion of the form constituted registration for the in-service education program. In addition to routine information necessary for communication with the teacher, the following data relative to background variables were furnished by each teacher: (1) number of high school credits in mathematics, (2) number of semester hours credit in college mathematics, (3) number of semester hours college credit in mathematics teaching methods, (4) highest degree attained, (5) undergraduate major, (6) sex, and (7) years of teaching experience. Data for each teacher were transferred directly from the information sheet filled out by the teacher to IBM code sheets and subsequently were punched into IBM Cards for use in the final analysis. The information furnished by teachers relative to mathematics background was verified by checking against transcripts in the personnel files of the Dallas Independent School District. One out of each five transcripts was checked in its entirety. No major discrepancies were found between the information furnished by the teachers and the information on the transcripts.

Mathematics background. The mathematics background of the eighty-nine teachers is described in Table 7 in terms of central tendency and variability in high school mathematics units, semester hours of college mathematics, and semester hours of college credit in mathematics teaching methods.

As indicated by the information in Table 7, there was considerable range on all three measures of mathematics background, with the greatest variability appearing in semester hours in college mathematics. These distributions were somewhat skewed, and the means and standard deviations are rather misleading without also considering the median and interquartile range. These data are presented in Table 8.

TABLE 7

Central Tendency and Variability of Selected Mathematics Background Variables for Eighty-Nine Elementary Teachers

Variable	Mean	Standard Deviation	Range
High school units in mathematics	3.17	.96	0—4.5
Semester hours in college mathematics	7.56	8.54	0—36
Semester hours in mathematics teaching methods	2.96	2.79	0—12

On examining the data in Table 8 it became apparent that there was less variation in high school mathematics background, but that in college mathematics background and background in mathematics teaching methods, over 25 per cent of the teachers had either no semester hours credit in mathematics or no mathematics teaching methods. Twenty-four teachers had no college mathematics and twenty-six had no courses in mathematics teaching methods. Five had neither college mathematics nor methods. It may be noted further that while the range in semester hours of college mathematics extended from 0–36, 57 per cent of the teachers had six or more hours credit and 30 per cent had nine or more hours credit.

TABLE 8

The Median, 25th and 75th Percentile of High School Credits in Mathematics, Semester Hours in College Mathematics, and Semester Hours in Mathematics Teaching Methods for Eighty-Nine Elementary Teachers

Variables	Median	25th Percentile (Q_1)	75th Percentile (Q_3)
High school credits in mathematics	3.0	3.0	4.0
Semester hours in college mathematics	6.0	0.0	9.0
Semester hours in mathematics teaching methods	3.0	0.0	3.0

General academic background. The background of teachers was described in terms of the undergraduate major, classified as either "Education" or "Other" and the highest degree attained, classified as "Bachelor's" or "Master's." In Table 9 the number and per cent of teachers in each of these classifications are presented.

TABLE 9

Composition of Population by Undergraduate Major and by Highest Degree Held

	Undergraduate Major					
	Education		Other		Total	
Degree Held	N	Percent	N	Percent	N	Percent
Bachelor's	17	48.6	23	42.6	40	44.9
Master's	18	51.4	31	57.4	49	55.1
Total	35	39.3	54	60.7	89	100.0

It is interesting to note that fifty-four teachers, 60.7 per cent of the total, majored in some field other than education at the undergraduate level. More than half of the population, 55.1 per cent, had earned the Master's degree.

Sex and years of teaching experience. The eighty-nine teachers in the study varied widely in terms of teaching experience. Information on central tendency and variability in years of experience for both men and women is included in Table 10. Years of experience for all teachers ranged from 1–41 years. The mean was 12.7 and the standard deviation was 9.89. Men teachers had less experience and less variability in years of experience than women teachers as indicated by the comparable means and standard deviations in Table 10.

TABLE 10

Composition of Population by Sex and by Years Teaching Experience

		Years Teaching Experience		
Sex	N	Mean	Standard Deviation	Range
Men	26	7.2	3.82	1—17
Women	63	15.7	11.43	1—41
Total	89	12.7	9.89	1—41

Personality Measures

Two personality traits of teachers were selected as potential control variables. These were authoritarianism and attitude toward teaching. Authoritarianism was measured by the Christie F-Scale, while attitude toward teaching was measured by the *Minnesosta Teacher Attitude Inventory*. These two instruments were distributed to teachers during one of the regular pre-testing sessions with instructions to complete them according to attached directions and return them in the stamped, self-addressed envelope furnished for that puprose. Machine scoring sheets and electrographic pencils were furnished each teacher. Completed answer sheets were machine scored, and the results were punched into data cards for analysis.

Christie F-Scale. The F-Scale[75] and Christie's Reverse F-Scale[76] were used as a measure of authoritarianism in this study. The F-Scale was originally developed to measure, at the personality level, incipient fascistic tendencies. It is now, however, more commonly interpreted as a measure of authoritarianism. One feature of this scale that has prompted the attention of a number of investigators has been its one-directional phrasing of test items which tended to elicit positive responses. Agreement with F-Scale items was considered to be indicative of potential fascism, disagreement as non-fascistic. Recognizing the problems inherent in the F-Scale relative to response set, Christie composed items which were reversals of the F-Scale.

In the present study, ten F-Scale items and ten reversals of F-Scale items were utilized. The F-Scale items utilized were numbers 2, 6, 8, 13, 31, 34, 37, 38, 42, and 44.[77] The original F-Scale item numbers for the reversals proposed by Christie were 3, 9, 13, 15, 16, 18, 25, 26, 28, and 30.[78] The respondent was requested to read each statement and to mark it according to how strongly he agreed or disagreed with it. A six point scale was utilized: −3, I disagree very much; −2, I disagree pretty much; −1, I disagree a little; +1, I agree a little; +2, I agree pretty much; and +3, I agree very much. No time limit was set for completion of the instrument; however, it was emphasized in the instructions that the respondent should not ponder over each question. It was pointed out that there were no right or wrong answers. In the scoring procedures, a constant of 60 was added to each score to eliminate negative scores. The mean score for the teachers in this study was 60.7 with a standard deviation of 11.7, indicating that the average teacher was fairly neutral in his response to the instrument.

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[75] T. W. Adorno and Others, *The Authoritarian Personality* (New York: Harper, 1950).

[76] Richard Christie, J. Havel, and B. Seidenberg, "Is the F Scale Irreversible?" *Journal of Abnormal and Social Psychology*, LVI (March, 1958), pp. 143–59.

[77] Adorno, *loc. cit.*, pp. 248, 255–57.

[78] Christie, *loc. cit.*

Minnesota Teacher Attitude Inventory. The MTAI[19] purports to measure attitudes of teachers toward children and school work. It consists of 150 items and was constructed utilizing empirical techniques. Items are stated in such a way as to allow the subject to indicate agreement or disagreement on a five point scale from Strongly Agree (SA) to Strongly Disagree (SD). The method of scoring is that of subtracting the number of "wrong" answers (answers not agreeing with the norm group, which was a stratified random sample from the teacher population of the State of Minnesota) from the number of "right" answers.

The emergence of the MTAI as a measure of attitude toward teaching has resulted from investigations carried on by its authors over the past fifteen years. They indicate that the attitudes of teachers toward children and school work can be measured with high reliabilty. The Minnesota Teacher Attitude Inventory is designed to measure those attitudes of a teacher which predict how well he will get along with pupils in interpersonal relationships and, indirectly, how well satisfied he is with teaching as a vocation.

The possible range of scores on the MTAI is from plus 150 to minus 150. Each response scored "right" has a value of plus one, and each response scored "wrong" has a value of minus one. The test is practically self administering. The subject merely reads the directions on the front page of the test booklet and then proceeds to answer each of the 150 items. There is no time limit on the test, but the subject is encouraged to work as rapidly as possible and to indicate first impressions rather than to ponder over any one item very long. Time for taking the test is usually from 20 to 30 minutes. In the present study, machine scoring sheets were provided subjects and the tests were machine scored. The constructors of the test advise that subjects be cautioned that there are no "right" or "wrong" answers with the MTAI, but that there are, rather, agreement or disagreement with specific attitude statements. In order to avoid a change in the accepted terminology, the authors have given "rights" and "wrongs" labels. They state, however, that no implication of correctness or incorrectness is intended.

The mean MTAI score for the teacher population of this study was 28.9 with a standard deviation of 35.7. The correlation between MTAI and Christie F was −.49.

Interrelationship Among Actuarial and Personality Data

Correlation coefficients (including biserial correlations for factors related to highest degree held, undergraduate level, and sex) among

TABLE 11

Correlation Coefficients between Selected Teacher Background Factors and Personality Variables for the Eighty-Nine Teachers in the Study

	Variables								
	A	B	C	D	E	F	G	H	I
Actuarial Factors									
A. High School Mathematics Units	1.00	.14	.22*	.15	.05	.21*	.17	.02	.03
B. College Mathematics Hours		1.00	.00	.03	.25	.01	.16	.07	−.20
C. College Mathematics Methods Hours			1.00	−.12	−.11	.25*	.29*	.02	−.05
D. Highest Degree				1.00	.03	−.16	.26*	.06	.03
E. Undergraduate Major					1.00	−.01	.08	−.03	−.19
F. Sex						1.00	.36†	−.01	.03
G. Years Teaching Experience							1.00	.06	−.19
Personality									
H. Christie F								1.00	−.49†
I. MTAI									1.00

* Significant at the one per cent point.
† Significant at the five per cent point.

selected background factors and personality variables are reported in Table 11. There was only one significant correlation among selected factors other than sex and years teaching experience. Units of high school mathematics was related significantly to semester hours of mathematics teaching methods.

Women teachers had more credit than men for both high school mathematics and mathematics teaching methods. Women also had significantly more years teaching experience than men. Those teachers with the most experience were also those who had Master's rather than Bachelor's degrees and tended to have undergraduate majors in areas other than education.

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[18] Walter W. Cook, Carroll H. Leeds, and Robert Callis, *Minnesota Teacher Attitude Inventory*, Manual (New York: The Psychological Corporation, 1951).

CHAPTER III

Teacher Reaction and Achievement

THE PROBLEM

The aspect of the study reported in this chapter was concerned with the relative effectiveness of four methods of in-service education as measured by change in teachers' achievement in mathematics and in understanding of methods of teaching mathematics. The dependent variables utilized included:

A. Change in teachers' achievement in selected aspects of mathematics emphasized in the in-service education series
B. Change in teachers' general mathematics achievement
C. Change in teachers' understanding of mathematics teaching tasks.

This chapter has been divided into four major sections. The first is concerned with the collection of the data. It includes a discussion of the instruments used, the administration of the instruments, and the preparation of the data for analysis. The second portion of this chapter is concerned with the general effectiveness of the in-service education program and considers three aspects, namely: (1) change between pre- and post-test measures for all teachers, (2) the extent of relationship of teacher change to actuarial and personality data, and (3) evidence of teacher reaction to various aspects of the in-service education program. The third section of this chapter is concerned with the relative effectiveness of the four methods of in-service education. Finally, the fourth section summarizes the results presented in this chapter in terms of the questions established at the outset of the study.

COLLECTION OF THE DATA

Description of the Instruments

Instruments selected or developed for use in this portion of the study include:

A. *Understanding Mathematics Test*
B. *Sequential Tests of Educational Progress—Mathematics, Level 2*
C. *Mathematics Teaching Tasks, Intermediate Grades.*

Understanding Mathematics Test. To measure the change in teachers' achievement in the specific phases of mathematics stressed in the in-service education series, the *Understanding Mathematics Test* was developed. In the development of this instrument, the most significant concepts stressed in the in-service education series were identified. The major concepts included in the in-service education program are included in Appendix A. Those concepts marked with an asterisk were the ones on which specific test items were based.

Multiple-choice items, designed to measure teacher understanding of these significant concepts, were formulated. A preliminary form of the test, composed of these potential test items, was administered to selected students in advanced and graduate education classes at The University of Texas during the summer of 1960. Questions and comments concerning each item were recorded during the administration of the test. Utilizing these comments, test items were then retained, deleted, or revised. Two parallel forms of the *Understanding Mathematics Test* which measured the same basic concepts were thus prepared. Each form of the revised test contained thirty-five items. The number of correct responses was used to determine the test score.

No attempt was made to validate the test by comparison with the results from other tests of known or assumed validity, there being no test available for this purpose. However, the test items were designed specifically to measure the concepts developed in this in-service education series. Further, they were then carefully analyzed by a jury, composed of a mathematician, a psychologist, and an elementary education professor. The conclusion of the jury was that this test would measure these concepts and that the two forms of the test were comparable. Construct validity for this test was thus assumed.

The reliability of Form A of the instrument was computed by the Spearman-Brown split-half reliability formula[80] using the post-test scores on ninety-six teachers who completed one aspect of the research program. The reliability coefficient thus determined was .97.

Sequential Tests of Educational Progress—Mathematics Level 2. To measure change in teachers' general mathematics achievement, an instrument was selected that measured broad understandings of basic mathematics concepts rather than one which measured achievement in specific mathematics skills. The *Sequential Tests of Educational Progress—Mathe-*

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[80] Allen L. Edwards, *Statistical Methods for the Behavioral Sciences* (New York: Rinehart, 1960), pp. 175–77.

matics, Level 2 was used for this purpose. Dressel, in reviewing the instrument for the *Fifth Mental Measurements Yearbook,* pointed out that the test does, to a remarkable degree, measure understanding and application rather than rote recall.[81] The instrument was reported to measure mastery of the following broad mathematical concepts: number and operation, symbolism, measurement and geometry, function and relation, deduction and inference, and probability and statistics.[82] Two comparable forms for Level 2 were available, Forms A and B.

Fifer observed that the standardization of STEP approached the highest standards of educational measurement. The techniques of sampling, equating, and norming were carefully carried out.[83] The Kuder-Richardson Formula 20 was used to estimate the reliability of the instrument. The STEP-Mathematics, Level 2, Form A yielded a reliability coefficient of .84.[84] Only Form A was analyzed in this reliability test; however, the publisher states that the results should characterize Form B reasonably well since the A and B forms are very similar in content.[85]

Mathematics Teaching Tasks, Intermediate Grades. To measure change in teacher achievement in some aspects of teaching method, *Mathematics Teaching Tasks, Intermediate Grades,* Forms E and F were used. This test, consisting of five tasks, was designed as a part of a research project at Indiana University. Over a three-year period, twenty problems concerning teaching methods were constructed and tried out with about four hundred students enrolled in undergraduate and graduate courses in arithmetic instruction. Problems found to be too difficult, or which could not be reliably scored, were eliminated.[86] A five-task test of teacher understanding of mathematics teaching methods was the result. Coefficients of reliability were computed independently for each of the five tasks. A coefficient of reliability of .78 was obtained when the estimate was based on Problems 1-E, 1-F; of .75 based on Problems 2-E, 2-F; of .90 based on Problems 3-E, 3-F; of .94 based on Problems 4-E, 4-F; and of .88 based on Problems 5-E and 5-F. The lowest reliability coefficient was .75 and the mean coefficient was .85.[87]

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[81] Paul L. Dressel, "Sequential Tests of Educational Progress," a review in the *Fifth Mental Measurements Yearbook,* ed. O. K. Buros (Highland Park, N. J.: The Gryphon Press, 1959), p. 570.

[82] Educational Testing Service, *Manual for Interpreting Scores—Mathematics, Sequential Tests of Educational Progress* (Princeton, N. J.: Educational Testing Service, 1957), p. 5.

[83] Gordon Fifer, "Sequential Tests of Educational Progress," a review in the *Fifth Mental Measurements Yearbook,* ed. O. K. Buros (Highland Park, N. J.: The Gryphon Press, 1959), p. 573.

[84] Educational Testing Service, *Technical Report, Sequential Tests of Educational Progress* (Princeton, N. J.: Educational Testing Service, 1947), p. 10.

[85] *Ibid.,* p. 9.

[86] Richard L. Turner, *Problem Solving Proficiency Among Elementary School Teachers, Part II* (Bloomington, Indiana: Institute of Educational Research, School of Education, Indiana University, 1960), p. 8.

Both forms of each of the three tests were used in the present study. For statistical analysis of the results raw scores were used in the *Understanding Mathematics Test;* converted scores were used in the STEP—Mathematics Level 2; and raw scores were converted to standard scores on the basis of pre-tests for use with the *Mathematics Teaching Tasks.*

Administration of Test Instruments

The pre-tests were administered in early October, 1960, prior to the beginning of the in-service education series on October 18. The battery of tests was administered in two one-and-one-half-hour testing sessions. Sessions were scheduled in two locations in Dallas which were centrally located in two major sections of the city. Teachers were permitted to attend either testing center. Testing time was 4:30–6:00 p.m. During the first testing day, teachers took the STEP—Mathematics, Level 2 and during the second day they took the *Understanding Mathematics Test* and *Mathematics Teaching Tasks—Intermediate Grades.* Teachers taking the first form in the pre-testing were administered the second form in a similar testing session for the post-test at the end of the study during the week of April 13. All tests were administered by members of the research team who had been trained in their administration.

GENERAL EFFECTIVENESS OF THE IN-SERVICE EDUCATION PROGRAM

The general effectiveness of the in-service education program was determined in a number of ways. In this chapter of the study, both the achievement measures of teachers and teachers' reactions to the in-service education program are reported.

Achievement Measures

Pre- and post-test means, standard deviations, and *t*-tests for teachers' achievement on the *Understanding Mathematics Test, STEP—Mathematics*, Level 2, and *Mathematics Teaching Tasks* are presented in Table 12.

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[87] Richard L. Turner, *Problem Solving Proficiency Among Elementary School Teachers, Part IV* (Bloomington, Indiana: Institute of Educational Research, School of Education, Indiana University, 1961), pp. 11–16.

On each of the three achievement measures, teachers as a total group made gains which were statistically significant at the one per cent point. The mean gain on the *Understanding Mathematics Test*, the test which was designed to measure specific aspects of mathematics most directly related to the in-service education program, was 3.57. Significant gains on the *STEP—Mathematics*, Level 2, and the *Mathematics Teaching Tasks* indicate that the in-service education program was effective in general mathematics achievement and in understanding of methods as well as in the more specific mathematics aspects of the study.

Correlation coefficients shown in Table 13 indicate that changes in achievement measures were unrelated to selected teacher factors except in one of the twenty-seven r's reported. Authoritarian teachers as measured by the Christie F scale tended to change more than other teachers on the test of *Mathematics Teaching Tasks*.

TABLE 12

Pre- and Post-Test Descriptions of the Achievement Test Scores of Eighty-Nine Teachers

	Pre-Test		Post-Test		Change			
Tests	Mean	SD	Mean	SD	Mean	r	t	P
Understanding Mathematics Test	14.30	3.45	17.87	4.30	3.57	.57	8.11	.01
STEP-Mathematics, Level 2	285.84	10.57	289.10	8.67	3.26	.78	3.88	.01
Mathematics Teaching Tasks	51.07	9.13	54.97	8.32	3.90	.37	4.29	.01

Reaction to the In-Service Education Program

One measure of the success of in-service education is the reaction of teachers to various aspects of the program. This section reports teacher reaction by the four in-service education teacher groups to a questionnaire which was mailed to all teachers and returned by the eighty-nine included in this report.

Reactions to specific programs. Teachers identified the three television and lecture-discussion topics they thought were most effective, the three

TABLE 13

Correlation Coefficients Obtained for Change in Teacher Achievement and Selected Teacher Factors for Eighty-Nine Teachers

	Change in Teacher Achievement		
Variables	*Understanding Mathematics Test*	STEP—*Mathematics* Level 2	*Mathematics Teaching Tasks*
Actuarial Factors			
High School Mathematics Units	—.11	—.06	.01
College Mathematics Hours	.20	—.15	.03
College Mathematics Methods Hours	—.09	—.04	—.02
Highest Degree	—.04	.07	.10
Undergraduate Degree	—.07	.11	—.16
Sex	—.19	—.01	—.01
Years Teaching Experience	—.04	.07	—.06
Personality			
Christie F	—.14	.12	.23*
MTAI	—.01	.12	—.17

* Significant at the five per cent point.

least effective, and the single most effective topic. Two of the topics, both Classroom Applications, were not included in the lecture-discussion series for reaction purpose because they had not been treated separately as such. Reactions of teachers to the program topics is reported in Table 14. The program topic "Base and Place" was rated most effective by teachers. The "Structure of the Number System," "Systems of Numeration," "Numbers and Numerals," and "The Fundamental Processes: Multiplication" were among those topics noted most effective. Program topics rated among the least effective were those related to the social application of mathematics, such as "Statistics," "Mathematics and the Fine Arts," "Shooting for the Stars," "Physics and Chemistry," etc.

Those program topics rated as most effective were among the first presented in the in-service education program. Their content was related to the arithmetic usually included in elementary programs and yet they contained concepts of mathematics new to most of these teachers. Those program topics rated by teachers as least effective came at the end of the in-service education series and were indirectly related to content usually taught in elementary schools.

Table 14

Number of Teacher Reactions to Each of the Program Topics as Most and as Least Effective

Program Topics	Three Most Effective	Three Least Effective	Single Most Effective
Introduction	4	7	0
Numbers and Numerals	19	4	7
Base and Place	52	3	39
Some Properties of Arithmetic	15	8	3
Classroom Applications	6	5	1
The Fundamental Processes: Addition	4	2	0
The Fundamental Processes: Multiplication	17	1	6
The Fundamental Processes: Subtraction and Division	9	3	5
Common Fractions	4	3	2
Decimal Fractions	6	3	1
Classroom Applications	3	13	0
The Structure of the Number System	25	1	3
Systems of Numeration	18	5	3
Development of Units of Measure	13	1	3
Exploding Universe of Mathematics	5	8	1
Creators of Mathematics	13	18	0
Concepts of Measurement	10	7	2
Algebra	1	8	0
Geometry	6	8	0
Statistics	4	27	0
Mathematics and the Fine Arts	5	35	0
Shooting for the Stars	2	21	0
Physics and Chemistry	0	24	1
Mathematics and Other Sciences	2	10	1

General reactions. Teachers' general reactions to the in-service education program were favorable as indicated in Table 15. Fifty-four per cent of all teachers rated it as "One of the best I have ever attended." Only three teachers thought it was "Generally fair," and although there appears to be little difference among percentages for the four teacher groups, it is of interest to note that all three who thought the program generally fair were in non-consultant groups.

Usefulness of the program. Thirty-seven of the eighty-eight teachers responding to this portion of the questionnaire reported it was "One of the most useful" in-service education programs (Table 16). The television-consultant group reported higher ratings for usefulness than other

TABLE 15

Teacher's General Reactions to the In-Service Education Program
N = 89

	In-Service Education Group									
	TV with Consultant		TV		F-F with Consultant		F-F		Total	
Reaction	N	per cent	N	per cent	N	per cent	N	per cent	N	per cent
1. One of the best I've ever attended	15	65	12	48	10	50	11	52	48	54
2. Generally good	8	35	11	44	10	50	9	43	38	43
3. Generally fair			2	08			1	05	3	03
4. Generally poor										
5. One of the poorest I've ever attended										

TABLE 16

Teachers' General Reactions to the Usefulness of the In-Service Education Program
N = 88

	In-Service Education Group									
	TV with Consultant		TV		F-F with Consultant		F-F		Total	
Reaction	N	per cent	N	per cent	N	per cent	N	per cent	N	per cent
1. One of the most useful	12	55	10	40	6	30	9	43	37	42
2. Generally useful	8	36	8	32	13	65	10	48	39	44
3. Of some use	2	9	7	28	1	5	2	9	12	14
4. Generally not useful										

teacher groups. Twenty-eight per cent of the television-non-consultant teachers reported it was only "Of some use." The chi square test indicated no significant differences, however, among these teacher groups.

Written materials. Teachers reacted favorably to the written materials (Table 17). Fifty-eight per cent gave these materials the highest possible rating. The face-to-face lecture-discussion groups rated these materials somewhat higher than did teachers in the television groups. These differences were not significant, however, when checked by chi square.

TABLE 17

Teachers' Reactions to the Content Presented Through Written Material
N = 86

	In-Service Education Group									
	TV with Consultant		TV		F-F with Consultant		F-F		Total	
Reaction	N	per cent	N	per cent	N	per cent	N	per cent	N	per cent
1. Very useful	10	43	13	54	14	70	13	68	50	58
2. Generally useful	11	48	7	29	5	24	6	32	29	34
3. Of some use	2	9	4	17					6	7
4. Generally not useful					1	5			1	01
5. Of no value										

Usefulness of content presented by television or face-to-face lecture-discussion. When reacting to the content as presented in the television or lecture-discussion series a wide range of responses resulted. The mode in most teacher groups was the reaction "Generally useful" (Table 18). Eighty-four per cent of all teachers reported it in one of the two top categories.

Usefulness of content presented by consultants. The reactions of teachers to consultants is reported in Table 19. Although there are substantial differences between teachers in the two in-service groups, these differences were not significant. No television teachers rated their consultants less than "Generally useful"; whereas among the face-to-face lecture-discussion group, two said the consultants were "Of some use" and one reaction was "Generally not useful."

Reactions to frequency of in-service education sessions. By far the majority of teachers thought the frequency of the sessions to be about right. Nine indicated they should have been less frequent and five thought they should be more frequent (Table 20).

Use of materials and information in the classroom. All but four of the teachers indicated that "Some" or "Very much" of the material had been utilized in their classrooms (Table 21). None of the four reporting "Very little" use was in the television-consultant group. Fifty-two per cent of the television-consultant teachers reported "Very much" use of these materials and less than half that percentage of the television-only group reported "Very much" use. This difference was significant at the five per cent point. There was little or no difference between the reactions to

TABLE 18

Teachers' Reactions to the Content Presented via Television or Face-to-Face Lecture-Discussion

N = 88

			In-Service Education Group											
	TV with Consultant		TV		Total		F-F with Consultant		F-F		Total		Grand Total	
Reaction	N	per cent	N	per cent	N	per cent	N	per cent	N	per cent	N	per cent	N	per cent
1. Very useful	9	39	6	24	15	31	9	45	8	40	17	43	32	36
2. Generally useful	11	48	13	52	24	50	8	40	11	55	19	47	43	49
3. Of some use	2	9	5	20	7	15	2	10	1	5	3	7	10	11
4. Generally not useful	1	4	1	4	2	4	1	5			1	3	3	3
5. Of no value														

TABLE 19

Teachers' Reactions to the Content Presented by the Consultant
N=52

	In-Service Education Group					
	TV with Consultant		F-F with Consultant		Total	
Reaction	N	per cent	N	per cent	N	per cent
1. Very useful	15	65	11	58	36	69
2. Generally useful	8	35	5	26	13	25
3. Of some use			2	11	2	04
4. Generally not useful			1	05	1	02

TABLE 20

Teachers' Reactions to the Frequency of the In-Service Education Sessions
N=88

	In-Service Education Group									
	TV with Consultant		TV		F-F with Consultant		F-F		Total	
Reaction	N	per cent	N	per cent	N	per cent	N	per cent	N	per cent
1. Should have been more frequent	2	08			1	05	2	10	5	06
2. About right	17	71	22	92	17	90	18	85	74	84
3. Should have been less frequent	5	21	2	08	1	05	1	05	9	10

TABLE 21

Teachers' Evaluations of the Extent to Which Materials and Information from the In-Service Education Program Were Utilized in the Classroom
N=89

	In-Service Education Group									
	TV with Consultant		TV		F-F with Consultant		F-F		Total	
Reaction	N	per cent	N	per cent	N	per cent	N	per cent	N	per cent
1. Very much	12	52	5	20*	7	37	7	33	31	35
2. Some	11	48	18	72	12	60	13	62	54	61
3. Very little			2	08	1	05	1	05	4	04

* Chi square test indicated that reactions of Television-Consultant and Television-only groups differed significantly at the five per cent point.

use of materials and information by teachers in the two face-to-face lecture-discussion groups.

Reactions to applicability for differing pupil groups. Most of the teachers in all groups indicated that the program material was most applicable to high academic achievement groups. This was less so for the face-to-face lecture-discussion teacher group than for other teacher groups. Only one teacher thought it was most applicable for the pupils in regular (heterogeneous) classes (Table 22).

TABLE 22

Teachers' Evaluations Indicating the Pupil Group to Which the Content of the In-Service Education Program Was Most Applicable

N=86

	In-Service Education Group									
	TV with Consultant		TV		F-F with Consultant		F-F		Total	
Reaction	N	per cent	N	per cent	N	per cent	N	per cent	N	per cent
1. High academic achievement groups	17	73	18	75	10	53	14	70	59	69
2. Regular groups	1	04	0	0	0	0	0	0	1	01
3. About the same for each	5	23	6	25	9	47	6	30	26	30

Relationships between teacher reactions and selected teacher factors. Teacher reactions to the in-service education program were unrelated to teacher change on achievement measures and to selected teacher factors other than the Christie F authoritarian scale. The teacher reaction scale ranged from 1 to 5 as positive to negative reaction, respectively. The authoritarian teacher received the high score on the F scale and thus positive correlations between Christie F and teacher reactions reported in Table 23 indicate high authoritarianism was related to negative reactions to the in-service program. Authoritarian teachers, significantly more than others, responded negatively to the in-service education program generally, to the usefulness of the content, and to the television or face-to-face lecture-discussion media of presentation.

Summary of teachers' reactions. Teachers' reactions to various aspects of the in-service education program were generally favorable. Differences among teacher groups were generally insignificant although the television-consultant group tended to react more favorably than other groups to: (1) the program in general, (2) the usefulness of the program, (3) the

TABLE 25

Correlation Coefficients of Teacher Reactions to Teacher Change, Selected Teacher Factors and Personality Factors of Eighty-Nine Teachers

	Teacher Reactions					
Variable	General	Usefulness	Written Materials	Television and F-F Lecture-Discussion	Frequency	Extent of Use
Teacher Change						
Understanding of Mathematics	—.06	—.08	—.09	.02	.08	—.09
STEP	.05	.09	.03	—.05	.01	—.12
Mathematics Teaching Tasks	.16	.02	—.01	.03	—.06	.07
Antecedent Factors						
High School Mathematics Units	—.13	—.10	—.20	—.16	—.05	—.05
College Mathematics Hours	—.05	—.15	—.12	—.20	—.05	.05
College Mathematics Methods Hours	—.05	—.04	—.13	.02	.03	—.12
Highest Degree	—.09	—.11	.03	—.14	—.08	.07
Undergraduate Degree	.00	—.08	—.13	—.12	—.10	.09
Sex	.03	—.11	—.15	—.16	—.12	.04
Years Teaching Experience	.13	.00	—.13	—.13	—.06	—.04
Personality						
Christie F	.21*	.29†	.12	.21*	.00	.08
MTAI	—.13	—.12	.00	.02	.05	.00

* Significant at five per cent point.
† Significant at one per cent point.

content presented by the consultant, and (4) utilization of materials in the classroom. While all but one of these differences were insignificant there appear to be trends in the reactions which attach an importance to the use of the consultant in conjunction with television which is not apparent in the differences between consultant and non-consultant face-to-face lecture-discussion groups.

RELATIVE EFFECTIVENESS OF THE FOUR METHODS OF IN-SERVICE EDUCATION

The relative effectiveness of the four methods of in-service education as it affected teachers' achievement measures was tested with the analysis of covariance statistical technique. Independent variables included in the research design of this aspect of the study included:

A. *In-Service Presentation Media*—Television versus face-to-face lecture-discussion

B. *Consultant*—Yes or no.

Specifically, four questions were asked which were related to this phase of the investigation:

A. What is the relative effectiveness of television and face-to-face lecture-discussion as media of in-service education in changing the mathematics understanding of teachers?

B. What is the relative effectiveness of television and face-to-face lecture-discussion as media of in-service education in changing teachers' understanding of selected aspects of mathematics teaching method?

C. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the mathematics understandings of teachers?

D. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing teachers' understandings of selected aspects of mathematics teaching method?

Selection of Control Variables Utilized in the Analyses

To identify teacher change on the achievement measures attributable to the various teacher in-service education methods being investigated, selected teacher factors which were thought might influence results were identified and controlled. In the initial assignment of teachers, research groups were balanced as nearly as possible on two criteria. These two factors were (1) teacher experience and (2) socio-economic level of school community. Studies by Wishart[88] and Ryans,[89] as well as others, have identified a number of variables related to teacher achievement. Teacher characteristics which were selected and utilized as potential variables to be statistically controlled were discussed in Chapter II and are included with correlations with pre- and post-test achievement measures in Table 24.

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[88] A. Paul Wishart, "The Relationship of Selected Teacher Factors to the Character and Scope of the Science Teaching Program in Self-Contained Elementary School Classrooms" (unpublished Ph.D. dissertation, The University of Texas, 1961).

[89] David G. Ryans, *Characteristics of Teachers* (Washington, D. C.: American Council on Education, 1960).

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Each of the intercorrelations among the pre-test measures and the dependent variables was significant at either the five or one per cent point. These correlations range from .21 to .68. Significant correlations were also indicated for college mathematics hours, for post-*Understanding Mathematics Test,* and for pre- and post- STEP—Mathematics, Level 2. The other significant correlation was between Christie F (authoritarianism) and the post-test *Understanding Mathematics Test.*

In the analysis of covariance for each of the achievement measures, control variables included the pre-test scores for all three achievement measures, hours of college mathematics, and Christie F. In effect, this equated all teachers on the three pre-test measures, in hours of college mathematics, and in authoritarianism as measured by the Christie F, while allowing the adjusted post-test scores to vary.

Analyses of Achievement Variables

Tables 25, 26, and 27 include data relative to analyses of covariance for each of the three achievement measures for teachers. In no instance was there a significant difference for either of the main effects or for the interaction. None of the F ratios approximated significance and, as a result, it must be concluded that the method of presentation as represented by the four methods of this study had similar effect on the achievement of teachers as represented by the teacher achievement measures used in this study.

In answer to four questions which were related to this phase of the investigation, it can be said that television and face-to-face lecture-discussion are equally effective in changing the mathematics understanding and the understanding of selected aspects of mathematics teaching method. It can also be said that consultant services as a supplement to television or face-to-face lecture-discussion methods did not alter the effectiveness of the in-service education program in terms of the teacher achievement measures.

SUMMARY OF ANALYSES OF TEACHER ACHIEVEMENT AND REACTION DATA

Reactions of teachers and change in teachers' achievement scores attest the general success of the in-service education program. Differences between pre- and post-test measures were significant for each of the three achievement measures reported in this chapter.

Eight questions pertinent to the analyses included in this chapter were

TABLE 24

Correlation Coeffients Obtained for Teacher Achievement and Potential Control Variables for Eighty-Nine Teachers

	Teacher Achievement					
	Understanding Mathematics Test		STEP-Mathematics, Level 2		Mathematics Teaching Tasks	
Potential Control Variables	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
Achievement Measures						
Understanding Mathematics Test (Fre)	1.00	.46†	.34†	.27*	.31†	.26*
STEP-*Mathematics,* Level 2 (Pre)			1.00	.68†	.37†	.21*
Mathematics Teaching Tasks (Pre)					1.00	.47†
Actuarial Factors						
High School Mathematics Units	.13	—.01	.16	.14	—.01	.00
College Mathematics Hours	.15	.31†	.30†	.23*	.02	.05
College Mathematics Methods Hours	.11	.01	—.04	—.09	—.04	—.06
Highest Degree	—.06	—.18	.01	—.05	—.05	.06
Undergraduate Major	—.08	—.01	.10	.04	—.04	—.12
Sex	—.02	.17	—.07	—.08	.14	.14
Years of Teaching Experience	—.06	—.09	—.20	—.19	—.11	—.18
Personality						
Christie F	—.18	—.27*	—.12	—.04	—.20	.02
MTAI	—.06	.07	—.03	—.05	.12	—.06

* Significant at the five per cent point.
† Significant at the one per cent point.

posed in the statement of the problem in Chapter I. Data reported in this chapter are summarized in terms of these questions.

1. What is the relative effectiveness of television and face-to-face lecture-discussion as media of in-service education in changing the mathematics understanding of teachers?
2. What is the relative effectiveness of television and face-to-face lecture-discussion as media of in-service education in changing teachers' understanding of selected aspects of mathematics teaching methods?
3. Are consultant services as a supplement to television or face-to-face

ABLE 25

Analysis of Covariance of Post-Understanding Mathematics Test Scores for Eighty-Nine Teachers with Adjustment for Pre-Understanding Mathematics Test, Pre-Step, Pre-Mathematics Teaching Tasks, Christie F, and Semester Hours of College Mathematics

Source of Variance	df	Adjusted Sum of Squares	Adjusted Mean Square	F	P
Presentation (P)	1	6.80	6.80	.056	
Consultant (C)	1	37.18	37.18	.305	
PC	1	12.22	12.22	.100	
Error	80	9752.71	121.91		

TABLE 26

Analysis of Covariance of Post-Step—Mathematics, Level 2 Test Scores for Eighty-Nine Teachers with Adjustment for Pre-Understanding Mathematics Test, Pre-Step, Pre-Mathematics Teaching Tasks, Christie F, and Semester Hours of College Mathematics

Source of Variance	df	Adjusted Sum of Squares	Adjusted Mean Square	F	P
Presentation (P)	1	.79	.79	.018	
Consultant (C)	1	6.89	6.89	.156	
PC	1	1.85	1.85	.042	
Error	80	3544.67	44.31		

TABLE 27

Analysis of Covariance of Post-Mathematics Teaching Tasks Test Scores for Eighty-Nine Teachers With Adjustment for Pre-Understanding Mathematics Test, Pre-Step, Pre-Mathematics Teaching Tasks, Christie F, and Semester Hours of College Mathematics

Source of Variance	df	Adjusted Sum of Squares	Adjusted Mean Square	F	P
Presentation (P)	1	44.95	44.95	.798	
Consultant (C)	1	23.04	23.04	.409	
PC	1	3.61	3.61	.064	
Error	80	4503.30	56.29		

lecture-discussion effective in changing the mathematics understandings of teachers?

4. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the teachers' understandings of selected aspects of mathematics teaching method?

No significant differences were reported for any one of the four in-service education methods. One must conclude that insofar as the dependent variables for teacher achievement measures are concerned, television with or without consultant services is as effective and no more effective than face-to-face lecture-discussion with or without consultant services, as media for in-service education.

5. What is the relative effectiveness of television and face-to-face lecture-discussion as methods of in-service education as determined by teachers' reactions to the in-service education program?
6. Are consultant services as a supplement to television or face-to-face lecture-discussion effective as determined by teachers' reactions to the in-service education program.

There was a general tendency for those teachers with whom consultants worked to react more favorably to various aspects of the in-service education program than those teachers without consultant services. This appeared to be particularly true with the television teachers and less so with the face-to-face lecture-discussion teachers. The only significant difference, however, was between reactions of television-only and television-consultant teachers. The television-consultant teachers reported having made greater classroom use of the materials and information of the in-service education program than did the television teachers who were without consultant services.

7. What is the relationship of change in teacher achievement to teacher actuarial and personality variables?

The only significant relationship between teacher achievement and actuarial and personality variables was a correlation of .23 between *Mathematics Teaching Tasks* and authoritarianism as measured by the Christie F scale.

8. What is the relationship of teacher reaction to the in-service education program to change in teacher achievement and teacher actuarial and personality variables?

Authoritarianism was the only variable related to teacher reactions to the in-service education program. Teachers low in authoritarianism reacted significantly more favorably than high authoritarian teachers to the general aspects of the in-service education program, to the usefulness of the program, and to the television or face-to-face lecture-discussion aspects of the program.

CHAPTER IV

Teachers' Classroom Practices

THE PROBLEM

In-service education programs designed to change understandings of both teachers and pupils might be expected to affect in some way the classroom practices teachers use as they work with pupils in their classes. Chapter III reported the reactions and achievement of teachers; Chapter V reports the achievement and interest of pupils; and this chapter reports information relative to classroom practices teachers used. Two questions directly related to the hypotheses of this study are the major concern of this chapter:

1. What is the relative effectiveness of television and face-to-face lecture-discussion methods of in-service education in changing the classroom practices of teachers?
2. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the classroom practices of teachers?

An additional question included was:

3. What is the relationship of change in teachers' classroom practices to teacher actuarial and personality variables, teacher reaction to the in-service education program, and change in teacher achievement?

Classroom practices of teachers were determined through the use of a pupil interview technique which involved a random selection of six pupils from one class of each of forty-five teachers in the study. Dependent variables for which data were gathered by use of this instrument included:

1. Qualitative dimension
    - A. Material
    - B. Activities
    - C. Organization
    - D. Teaching Aids
    - E. Evaluation
    - F. Total Score
2. Quantitative dimension
    - A. Amount of discussion
    - B. Number of non-textbook activities
    - C. Number of non-textbook materials used

Collecting the Data

Development of the Interview Instrument

During the summer of 1960 an Interview Question Schedule and a Rating Scale (Appendix C) were developed to describe classroom practices of elementary school mathematics teachers. Procedures used by Shannon[90] and Wishart[91] in the development of a classroom practices interview schedule for science furnished the original pattern for the development of this instrument.

The first task in designing the interview instrument was to identify the components of the elementary mathematics program. Major components identified and organized were: (1) materials, (2) activities, (3) organization, (4) teaching aids, and (5) evaluation.

A schedule of questions, designed to elicit pupil responses concerning these major components of an elementary mathematics program, was formulated. The instrument was designed to take full advantage of a non-directive question technique so as to avoid value-laden items and direct cues which might bias the results. Questions were designed to eliminate responses at the "feeling level" by avoiding the use of direct reference to the teacher.[92] Questions of broad scope introduced each of the component areas of the instrument. Thus desired information was obtained with a minimum of the more direct "probing" questions.

As a pilot test, a list of probable responses to each question was developed through a series of sound-recorded individual interviews with five children. Quantifying the information obtained from these interviews for analyses was achieved by recording data on two dimensions of classroom practice: (1) qualitative dimension and (2) quantitative dimension.

Qualitative dimension. The qualitative dimension described the extent to which teachers' classroom practices were "textbook-centered" or "child-centered." Responses to the twenty-seven items on the Question Schedule were evaluated by a five-point rating scale. The scale was based on a continuum which ranged from textbook-centered practices through teacher-centered practices to child-centered practices. Scaled ratings permitted the classification of responses according to the type of instructional program represented:

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[90] Noma Gail Shannon, "The Development of an Interview Instrument Designed to Determine the Scope and Character of an Elementary School Science Classroom Program" (unpublished M.Ed. thesis, The University of Texas, 1961).

[91] Wishart, *loc. cit.*

[92] Donald M. Medley and Alix A. Klein, "Measuring Classroom Behavior with a Pupil-Reaction Inventory," *Elementary School Journal*, LVII (March 1957), pp. 315–19.

1. Text-centered—scaled rating of 1
2. Text-teacher-centered—scaled rating of 2
3. Teacher-centered—scaled rating of 3
4. Teacher-child-centered—scaled rating of 4
5. Child-centered—scaled rating of 5

The total score ranged from a minimum of twenty-seven to a possible maximum of one hundred thirty-five.

Subscores on the qualitative dimension were obtained by groupings of the twenty-seven item ratings. Subscores were obtained on:

1. Materials
2. Activities
3. Organization
4. Teaching Aids
5. Evaluation

Instructional materials included the use of single or multiple adoptions of textbooks, library books, pamphlets, and mimeographed or other printed materials. The activities subscore included the use of "free time," homework, and activities outside the routine textbook approach. The organization of the classroom referred to the character and extent of individualized instruction and the extent to which pupils initiated and took part in class discussions. The fourth component, teaching aids, referred to the source of graphic and manipulative teaching aids and the extent to which these were utilized for individual exploration. Information related to evaluation dealt with the number, kind, and scource of tests and the extent to which pupils were involved in test making and in evaluating their own progress in mathematics. For specific questions used in obtaining the data see Appendix C.

Quantitative dimension. Scores tabulated separately from qualitative rating scale scores were obtained from responses to six questions which were distributed throughout the Question Schedule. This dimension described (1) the amount of class discussion; (2) the number of trade books, library books, encyclopedias, pamphlets, the number of films, film-strips, and slides used, and the number of graphic and manipulative aids used; and (3) the number of special activities and "project-related" activities. Thus, subscores obtained on the quantitative dimension were:

(1) Amount of discussion
(2) Number of non-textbook materials utilized
(3) Number of non-textbook activities.

The amount of discussion was described by the per cent of class time reportedly spent in discussion. The other two subscores represented the total number of items tallied in each area.

Reliability and Validity. Reliability and validity of the Interview Instrument was tested in a number of ways. First, to measure scoring reliability interviews were conducted with six randomly selected children from each of four teachers' classrooms. Each interview was recorded on Dictaphone belts. Two recorders independently scored each of these recordings. Rank-order correlation coefficients were computed using the scores of these two recorders for each of the four classes. These correlation coefficients, computed for twenty-nine items on the interview instrument, were .68, .71, .87, and .95.

Second, reporting reliability was tested by the extent to which teachers and pupils within a classroom agree in their perceptions of classroom practices. Two groups of six randomly selected pupils from each of two classrooms were interviewed. In each classroom the same interviewer worked with both groups of pupils and a second interviewer interviewed the teacher. Correlations between pupil groups were .81 and .86 as reported in Table 28. The correlations between teacher and pupil interviews were .46, .59, .60, .65. Although there was high agreement between pupil groups, lower correlations were reported between teachers and pupils.

Third, the validity of the Interview Instrument was determined by interviewing the teacher and two groups of pupils from each of two classrooms. Observations were made in each classroom for five forty-to fifty-minute periods on five consecutive days. After completion of the last observation, each teacher was interviewed with the same questions which the pupils in her class had been asked. Correlations which were computed between scores obtained by observation, pupil-interview, and teacher-interview are shown in Table 28. Validity measures between observation and teacher interviews were .65 and .89. Correlations between observation and pupil interviews were somewhat lower at .42, .56, .64, and .79.

TABLE 28

Validity and Reliability Correlation Coefficients between Teacher and Pupil Observations and Interviews

Teacher	Classroom Observation	Teacher Interview	Pupil Interview Group A	Pupil Interview Group B
Teacher I				
Validity				
Classroom Observation	1.00	.89	.42	.56
Reliability				
Teacher Interview		1.00	.46	.59
Pupil Interview				
Group A			1.00	.86
Group B				1.00
Teacher II				
Validity				
Classroom Observation	1.00	.65	.79	.64
Reliability				
Teacher Interview		1.00	.60	.65
Pupil Interview				
Group A			1.00	.81
Group B				1.00

Selection of the Population

Forty-eight teachers were originally selected for inclusion in this study of classroom practices. Two teachers were selected from each of the original subgroups determined by the independent variables—in-service presentation media, consultant, grade, and class achievement grouping. Forty-five of these teachers completed the project, and all descriptions and analyses reported in this chapter are in terms of these forty-five teachers. The distribution of these teachers by research groups is shown in Table 29.

Interviewing Procedures

Six pupils from each class included in the study were interviewed to elicit responses relative to the classroom practices of their teacher. A table of random numbers was used as an aid in the selection of pupils to be interviewed. Pupils were interviewed early in October prior to the first in-service education program, and again in April at the culmination

TABLE 29

Distribution of Forty-Five Teachers and Their Classes As Utilized in the Classroom Practices Portion of the Study

In-Service Presentation Media (P)	Grade (G)	Class Achievement Grouping (A)	Consultant (C) Yes	Consultant (C) No	Total
Television	4	High Achievement	2	2	
		Heterogeneous	2	2	
	5	High Achievement	2	2	
		Heterogeneous	2	3	
	6	High Achievement	2	2	
		Heterogeneous	2	2	
Sub-Total			12	13	25
Face-to-Face Lecture-Discussion	4	High Achievement	1	1	
		Heterogeneous	2	2	
	5	High Achievement	2	2	
		Heterogeneous	1	1	
	6	High Achievement	2	2	
		Heterogeneous	2	2	
Sub-Total			10	10	20
Total			22	23	45

of the in-service education program. The second interview was held with six randomly selected pupils from each class and each pupil group may have had one or more individuals who had been included in the first interview.

The interview. All interviews were conducted by two members of the research staff. To insure standardization of procedures, the following steps were taken. First, reliability checks were made as reported in the above section concerned with reliability and validity, and second, the two interviewers discussed procedures for the specific aspects of the interviews and developed a set of instructions in keeping with the following statements:

1. The interviewer introduced herself to the group and asked for the names of each of the pupils.
2. The purpose of the interview was explained to the pupils.
3. The Dictaphone was demonstrated and effective methods of speaking for sound recording were discussed.

4. The name of the teacher, the name of the school, grade level, and class section were entered on the Dictaphone belt.
5. Identification information was played back to check the operation of the machine.
6. The introductory question was asked and this was followed by a brief discussion.
7. Questions were asked according to the Interview Question Schedule until all questions had been asked.
8. Following the listed questions, the interviewer asked if the students could think of anything important that had not been discussed in the interview.
9. The interviewer ended by asking each pupil to tell about his favorite day in arithmetic during the year.
10. The interviewer played back to the group these last comments and expressed her thanks for their cooperation.
11. Each dictabelt was identified and filed for future analysis.

Analysis of the interview. The two interviewers individually listened to their interviews and tabulated data from each one on the Interview Schedules. To insure the highest possible reliability in the scoring of information obtained from the dictabelts, a coding schedule was prepared and used in the interpretation of interview data (Appendix C).

GENERAL EFFECTIVENESS OF THE IN-SERVICE EDUCATION PROGRAM

Post-scores on the Classroom Practices Interview Instrument were consistently higher than pre-scores. Range and mean scores are reported in Table 30. The graph in Figure 1 illustrates the change away from text-centeredness which took place during the in-service education program. The big change was the lessening of the mean score on text-centeredness.

To evaluate the general effectiveness of the in-service education program in changing the classroom practices of teachers, mean scores and standard deviations for subscores of the Qualitative and Quantitative Dimensions of classroom practices were computed from the pre- and post-interview data. These data are presented in Table 31 in which t-tests of the significance of the differences between these means are also presented.

Three of the five subscores of the Qualitative Dimension resulted in significant differences between pre- and post-interview measures. High scores on this dimension were related to teacher-centered or child-centered activities as opposed to text-centered methods of instruction. For each subscore the post-mean was greater than the pre-mean. This

TABLE 30

Central Tendency and Variability for Subscores of the Qualitative and Quantitative Dimensions of the Interview Instrument for Forty-Five Teachers

Dimensions	Total Possible Score	Range		Mean	
		Pre	Post	Pre	Post
Qualitative					
Materials	45	9–33	14–29	16.73	19.91
Activities	15	4–11	4–11	7.24	7.69
Teaching Aids	25	5–24	5–25	9.49	13.87
Organization	25	5–18	9–20	10.16	11.71
Evaluation	20	6–17	6–17	9.02	9.73
Total Score	130	36–84	43–87	52.64	63.02
Text	26	3–19	1–15	11.67	7.78
Text—Teacher	26	2–13	3–12	6.80	7.38
Teacher	26	0–11	2–10	3.80	5.36
Teacher—Child	26	0–10	0– 8	2.49	3.16
Child	26	0– 8	0– 7	1.22	2.29
Quantitative					
Amount of Discussion (Per Cent)	....	10–90	10–90	28.22	34.33
Number of Non-Textbook Activities	....	0– 4	0–15	.80	3.38
Number of Non-Textbook Materials Used	....	0–15	0–23	3.20	7.91

indicates that during the in-service education program teachers tended to move away from text-centered or text-teacher-centered approaches in their methods of instruction.

The subscales of the Quantitative Dimension resulted in significant differences between the pre- and post-means in each instance. Teachers at the end of the project were reported by pupils to be using significantly greater amounts of time in classroom discussion, they involved pupils in a greater number of non-textbook activities, and they used a greater number of non-textbook materials than reportedly had been used at the time of the October pupil interviews.

RELATIVE EFFECTIVENESS OF THE FOUR METHODS OF IN-SERVICE EDUCATION

The relative effectiveness of the four methods of in-service education in changing the classroom practices of teachers was determined by use

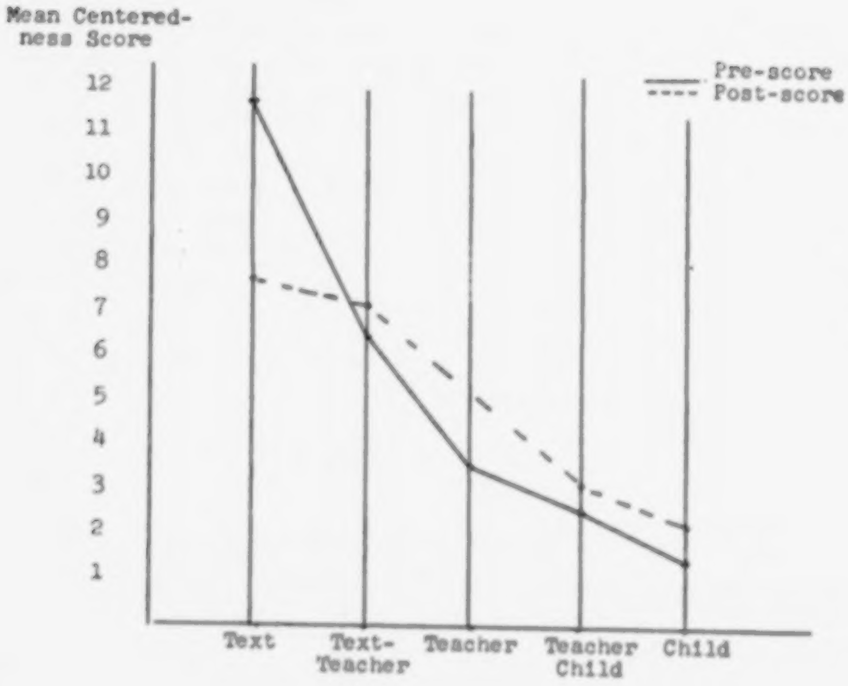

FIGURE 1
Pre- and Post-scores Indicating Centeredness of the Teaching Practices for Forty-five Teachers

of the analysis of covariance. Independent variables in the portion of the study reported in this chapter included:

A. *In-Service Presentation Media*—Television versus face-to-face lecture-discussion

B. *Consultant*—Yes or no

C. *Grade*—Four, five, or six

D. *Class Achievement Grouping*—High achievement grouped classes versus heterogeneously grouped classes

Qualitative Dimension

Selection of control variables utilized in the analyses. Control variables were selected so that change in classroom practices attributable to

TABLE 31

Pre-and Post-Test Descriptions of Classroom Practices As Determined by Pupil Interviews for Forty-Five Teachers

Classroom Practices	Pre-test Mean	Pre-test S.D.	Post-test Mean	Post-test S.D.	Mean Change	r	t	p
Qualitative								
Materials	16.73	4.85	19.91	4.58	3.18	.29	3.786	.01
Activities	7.24	1.97	7.69	1.99	.45	.33	1.286	—
Organization	9.49	..77	13.87	4.66	4.38	.56	7.300	.01
Teaching Aids	10.16	3.10	11.71	2.15	1.55	.17	2.981	.01
Evaluation	9.02	2.65	9.73	2.31	.71	.55	1.511	—
Total Score	52.64	12.17	63.02	11.53	10.38	.55	6.241	.01
Quantitative								
Amount of Discussion	28.22	21.22	34.33	16.11	5.11	.36	1.530	—
Number of Non-Textbook Activities	.80	1.15	3.38	3.39	2.24	.67	5.463	.01
Number of Non-Textbook Materials Used	3.20	3.40	7.91	5.45	2.05	.62	3.203	.01

the in-service education program might be isolated and tested. Pre-measures on the dependent variables, selected teacher factors, and personality variables were correlated with pre- and post-measures of classroom practices. These correlation coefficients are presented in Table 32. (Personality measures and actuarial factors were identified and described in Chapter II).

Pre-measures on the classroom practices scores were significantly related to post-measures. Units of high school mathematics were negatively related to several of the Qualitative Dimensions, and scores on the authoritarian scale (Christie F) were significantly related to a number of the dependent variable scores. Thus, the pre-measure on each respective variable, units of high school mathematics, Cattell F, and Christie F were used as control variables of the analyses of covariance which were used to test the significance of differences among the classroom practices measures.

Analyses of covariance for qualitative dimension variables. The analyses of covariance are presented in Tables 33, 34, 35, 36, 37, 38, and 39 which follow. In only one instance was there a significant difference for either of the main effects or for any of the interactions. In the case of the dependent variable, Materials, the first main effect, In-service Presen-

TABLE 32

Correlation Coefficients Obtained for the Qualitative Dimension of the Classroom Practices of Forty-Five Teachers and Potential Control Variables

Potential Control Variables	Classroom Practices											
	Materials		Activities		Organization		Teaching Aids		Evaluation		Total Score	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Classroom Practices												
Qualitative Dimension												
Materials (Pre)	1.00	.29*	.42*	.29*	.42†	.32*	.35*	.25	.66†	.54†	.83†	.44†
Activities (Pre)			1.00	.33*	.39†	.35*	.39†	.01	.33*	.23	.62†	.28
Organization (Pre)					1.00	.57†	.51†	.14	.37*	.32*	.75†	.51†
Teaching Aids (Pre)							1.00	.17	.33*	.23	.69†	.34*
Evaluation (Pre)									1.00	.55†	.74†	.37*
Total Score (Pre)											1.00	.55†
Actuarial Factors												
High School Mathematics Units	—.33*	—.15	—.12	—.20	—.23	—.29*	—.07	—.22	—.46†	—.31*	—.34*	—.31*
College Mathematics Hours	.16	.02	—.17	.06	.17	.00	.09	.16	.29*	.25	.17	.10
College Mathematics Methods Hours	.13	—.01	—.04	.00	.09	.12	.07	.07	.25	.03	.09	.05
Highest Degree	.06	.09	—.15	—.20	—.22	—.34*	.19	.09	.01	.06	—.02	—.10
Undergraduate Degree	.06	—.10	—.01	—.04	—.18	.12	—.12	.16	.01	.08	—.06	.05
Sex	.21	—.12	.12	—.01	.25	.25	.17	—.14	—.05	—.10	.23	—.01
Years Teaching Exp.	.27	.03	—.22	—.29*	—.08	—.23	.11	.06	.09	.13	.10	—.10
Personality												
Cattell F	.35*	.21	.30	.04	.13	.09	.04	.05	.19	.07	—.26	—.12
Christie F	.04	—.17	.10	—.29*	—.08	—.20	—.05	—.19	.02	—.23	.00	—.29*
MTAI	—.04	.18	.13	—.29*	.09	.07	.21	.19	—.01	.16	.10	.22

* Significant at the five per cent point.
† Significant at the one per cent point.

TABLE 33

Analysis of Covariance of Classroom Practices Materials Scores with Adjustment for Cattell F, Christie F, High School Mathematics Units and Pre-Materials Scores for Forty-Five Teachers

Source of Variance	df	Adjusted Sum of Squares	Adjusted Mean Square	F	P
Presentation (P)	1	87.09	87.09	5.925	<.05
Consultant (C)	1	43.41	43.41	2.953	
Achievement (A)	1	4.36	4.36	.296	
Grade (G)	2	12.07	6.03	.410	
PC	1	18.14	18.14	1.234	
PA	1	.80	.80	.055	
PG	2	25.17	12.58	.856	
CA	1	11.02	11.02	.750	
CG	2	20.84	10.42	.709	
AG	2	56.71	28.35	1.929	
PCA	1	11.92	11.92	.811	
PCG	2	10.47	5.23	.356	
PAG	2	76.12	38.06	2.589	
CAG	2	33.71	16.85	1.147	
PCAG	2	17.74	8.87	.603	
Error	17	349.87	14.70		

TABLE 34

Adjusted Parameter Estimates in the Analysis of Covariance for Classroom Practices Materials Scores of Forty-Five Teachers

In-Service Presentation Media (P)	Adjusted Parameter
Television	36.65
Face-to-Face Lecture-Discussion	40.53

tation Media, was significant at the five per cent point. Upon investigation of the estimated parameters, it was found that teachers in the face-to-face lecture-discussion group had reportedly changed more in the manner in which they used materials than had teachers in the television group. This change had been in the direction away from a text-centered approach. In view of the fact that this was one significant (.05) main effect out of thirty-six, this single significant finding probably should be considered a chance factor.

TABLE 35

Analysis of Covariance of Classroom Practices Activities Scores with Adjustment for Cattell F, Christie F, High School Mathematics Units, and Pre-Activities Scores for Forty-Five Teachers

Source of Variance	df	Adjusted Sum of Scores	Adjusted Mean Score	F	P
Presentation (P)	1	4.68	4.68	.899	
Consultant (C)	1	.01	.01	.002	
Achievement (A)	1	4.50	4.50	.864	
Grade (G)	2	.41	.21	.040	
PC	1	.57	.57	.109	
PA	1	.50	.50	.096	
PG	2	4.12	2.06	.397	
CA	1	.61	.61	.117	
CG	2	11.16	5.58	1.072	
AG	2	11.26	5.63	1.081	
PCA	1	8.72	8.72	1.675	
PCG	2	4.67	2.33	.448	
PAG	2	7.10	3.55	.682	
CAG	2	3.59	1.79	.344	
PCAG	2	17.48	8.74	1.679	
Error	17	88.52	5.21		

TABLE 36

Analysis of Covariance of Classroom Practices Teaching Aids Scores with Adjustment for Cattell F, Christie F, High School Mathematics Units, and Pre-Teaching Aids Scores for Forty-Five Teachers

Source of Variance	df	Adjusted Sum of Scores	Adjusted Mean Score	F	P
Presentation (P)	1	12.22	12.22	.750	
Consultant (C)	1	1.83	1.83	.112	
Achievement (A)	1	2.16	2.16	.132	
Grade (G)	2	15.50	7.75	.476	
PC	1	28.77	28.77	1.765	
PA	1	49.47	49.47	3.036	
PG	2	6.49	3.24	.199	
CA	1	7.88	7.88	.484	
CG	2	41.61	20.80	1.277	
AG	2	18.91	9.46	.580	
PCA	1	5.34	5.34	.328	
PCG	2	22.45	11.23	.689	
PAG	2	10.43	5.21	.320	
CAG	2	48.49	24.25	1.488	
PCAG	2	2.78	1.39	.085	
Error	17	277.04	16.30		

TABLE 37

Analysis of Covariance of Classroom Practices Organization Scores with Adjustment for Cattell F, Christie F, High School Mathematics Units, and Pre-Organization Scores for Forty-Five Teachers

Source of Variance	df	Adjusted Sum of Scores	Adjusted Mean Score	F	P
Presentation (P)	1	.03	.03	.009	
Consultant (C)	1	1.77	1.77	.519	
Achievement (A)	1	6.15	6.15	1.805	
Grade (G)	2	4.73	2.37	.695	
PC	1	1.43	1.43	.420	
PA	1	.03	.03	.009	
PG	2	1.47	.74	.216	
CA	1	6.23	6.23	1.829	
CG	2	1.07	.53	.156	
AG	2	.82	.41	.120	
PCA	1	.19	.19	.055	
PCG	2	8.07	4.03	1.184	
PAG	2	7.30	3.65	1.072	
CAG	2	14.07	7.03	2.065	
PCAG	2	3.06	1.53	.449	
Error	17	57.89	3.41		

TABLE 38

Analysis of Covariance of Classroom Practices Evaluation Scores with Adjustment for Cattell F, Christie F, High School Mathematics Units, and Pre-Evaluation Scores for Forty-Five Teachers

Source of Variance	df	Adjusted Sum of Scores	Adjusted Mean Score	F	P
Presentation (P)	1	17.10	17.10	4.293	
Consultant (C)	1	4.58	4.58	1.150	
Achievement (A)	1	.00	.00	.001	
Grade (G)	2	6.81	3.40	.855	
PC	1	.30	.30	.076	
PA	1	2.08	2.08	.523	
PG	2	.70	.35	.088	
CA	1	6.18	6.18	1.551	
CG	2	5.25	2.62	.659	
AG	2	6.83	3.41	.857	
PCA	1	.01	.01	.003	
PCG	2	2.42	1.21	.304	
PAG	2	4.36	2.18	.547	
CAG	2	2.86	1.43	.360	
PCAG	2	9.21	4.61	1.156	
Error	17	67.72	3.98		

TABLE 39

Analysis of Covariance of Classroom Practices, Total Scores with Adjustment for Cattell F, Christie F, High School Mathematics Units, and Pre-Classroom Practices Total Scores for Forty-Five Teachers

Source of Variance	df	Adjusted Sum of Scores	Adjusted Mean Score	F	P
Presentation (P)	1	73.64	73.64	.723	
Consultant (C)	1	66.03	66.03	.649	
Achievement (A)	1	.02	.02	.000	
Grade (G)	2	54.81	27.40	.269	
PC	1	182.21	182.21	1.790	
PA	1	37.42	37.42	.368	
PG	2	7.17	3.59	.035	
CA	1	93.96	93.96	.923	
CG	2	90.88	45.44	.446	
AG	2	176.60	88.30	.867	
PCA	1	4.69	4.69	.046	
PCG	2	54.66	27.33	.268	
PAG	2	142.46	71.23	.700	
CAG	2	320.41	160.21	1.574	
PCAG	2	65.81	32.91	.323	
Error	17	1730.49	101.79		

Quantitative Dimension

Selection of control variables utilized in the analyses. Control variables were selected on the basis of data reported in Table 40. Pre-measures on each of the quantitative variables were related significantly to the post-measure for that variable. Although there were occasional significant correlations of actuarial and personality factors to pre-measures on the quantitative variables, none represented a pattern which resulted in its selection as a control variable. Thus, for the components of the Quantitative Dimension, the pre-measure provided the only control variable used in each analysis of covariance.

Analyses of covariance for quantitative dimension variables. The analysis of covariance for the Amount of Discussion scores is presented in Table 41. The only source of variation which approximated significance was Grade. This difference was significant at the five per cent point.

Adjusted prarameter estimates are shown in Table 42. While these estimates have little apparent relationship to the original scores, they do represent the differences in the grade groups. Grade four teachers changed

TABLE 40

Correlation Coefficients Obtained for the Quantitative Dimension of the Classroom Practices of Forty-Five Teachers and Potential Control Variables

Potential Control Variables	Classroom Practices					
	Amount of Discussion		Number of Non-Textbook Activities		Number of Non-Textbook Materials Used	
	Pre	Post	Pre	Post	Pre	Post
Classroom Practices						
Quantitative Dimension						
Amount of Discussion (Pre)	1.00	.36*	.19	.23	.26	.31*
Number of Non-Textbook Activities (Pre)			1.00	.67†	.62†	.31*
Number of Non-Textbook Materials Used (Pre)					1.00	.62†
Actuarial Factors						
High School Mathematics Units	.06	—.07	—.22	—.29*	—.24	—.09
College Mathematics Hours	—.17	—.15	.37*	.04	.20	—.07
College Mathematics Methods Hours	—.16	.04	—.17	.09	—.05	—.01
Highest Degree	.27	.16	—.23	—.13	—.04	—.09
Undergraduate Degree	—.11	—.01	—.07	—.02	.01	.04
Sex	—.04	—.02	.17	.09	.28	.23
Years Teaching Experience	—.03	—.06	—.09	—.24	.03	—.10
Personality						
Christie F	—.07	.00	—.08	—.33*	—.09	—.17
MTAI	.28	—.04	.10	.16	.01	.14

* Significant at the five per cent point.
† Significant at the one per cent point.

TABLE 41

Analysis of Covariance of Post-Amount of Discussion Scores for Forty-Five Teachers with Adjustment for Pre-Amount of Discussion Scores

Source of Variance	df	Adjusted Sum of Squares	Adjusted Mean Square	F	P
Presentation (P)	1	345.02	345.02	1.628	
Consultant (C)	1	94.95	94.95	.448	
Achievement (A)	1	29.80	29.80	.141	
Grade (G)	2	1806.38	903.19	4.260	<.05
PC	1	258.20	258.20	1.218	
PA	1	67.66	67.66	.319	
PG	2	342.26	171.13	.807	
CA	1	907.84	907.84	4.282	
CG	2	138.86	69.43	.328	
AG	2	74.88	37.44	.177	
PCA	1	391.58	391.58	1.847	
PCG	2	513.59	256.80	1.211	
PAG	2	479.21	239.60	1.130	
CAG	2	22.32	11.16	.053	
PCAG	2	178.01	89.01	.420	
Error	20	4239.96	212.00		

TABLE 42

Adjusted Parameter Estimates in the Analysis of Covariance for Post-Amount of Discussion Scores of Forty-Five Teachers of Grade

Grade	Adjusted Parameter
4	5.62
5	21.81
6	19.87

significantly less in the amount of class time devoted to discussion than teachers in grades five and six.

There were no significant differences among groups in the changes which took place as represented by the non-textbook activities score. The analysis of covariance for these scores is shown in Table 43.

The analysis of covariance reported in Table 44 indicates a significant interaction for the number of non-textbook materials scores. Adjusted parameter estimates included in Table 45 favor fourth grade, non-consultant, high achievement groups over fourth grade consultant, high achievement groups and fourth grade, non-consultant, heterogeneous groups.

TABLE 43

Analysis of Covariance of Post-Number of Non-Textbook Activities Scores for Forty-Five Teachers with Adjustment for Pre-Number of Non-Textbook Activities Scores

Source of Variance	Adjusted			
	df	Sum of Squares	Mean Square	F
Presentation (P)	1	1.85	1.85	.225
Consultant (C)	1	5.83	5.83	.709
Achievement (A)	1	.95	.95	.116
Grade (G)	2	16.37	8.19	.996
PC	1	2.82	2.82	.344
PA	1	6.88	6.88	.837
PG	2	.24	.12	.015
CA	1	.31	.31	.038
CG	2	5.50	2.75	.335
AG	2	18.58	9.29	1.130
PCA	1	.52	.52	.063
PCG	2	3.93	1.97	.240
PAG	2	2.59	1.29	.157
CAG	2	29.79	14.90	1.813
PCAG	2	.35	.17	.021
Error	20	164.40	8.22	

TABLE 44

Analysis of Covariance of Post-Number of Non-Textbook Materials Scores for Forty-Five Teachers with Adjustment for Pre-Number of Non-Textbook Materials Scores

Source of Variance	Adjusted				
	df	Sum of Squares	Mean Square	F	P
Presentation (P)	1	13.89	13.89	.659	
Consultant (C)	1	.26	.26	.012	
Achievement (A)	1	9.38	9.38	.445	
Grade (G)	2	1.19	.59	.028	
PC	1	14.98	14.98	.710	
PA	1	10.55	10.55	.500	
PG	2	11.39	5.70	.270	
CA	1	13.49	13.49	.640	
CG	2	7.75	3.88	.184	
AG	2	45.28	22.64	1.074	
PCA	1	9.98	9.98	.473	
PCG	2	1.21	.60	.029	
PAG	2	44.70	22.35	1.060	
CAG	2	172.58	86.29	4.092	<.05
PCAG	2	29.51	14.75	.700	
Error	20	421.73	21.09		

TABLE 45

Adjusted Parameter Estimates in the Analysis of Covariance for Post-Number of Non-Textbook Materials Scores of Forty-Five Teachers by Consultant, Achievement, and Grade (CAG)

Consultant (C)	Grade (G)	Class Achievement Group (A)	
		High Achievement	Heterogeneous
Yes	4	1.30	6.78
	5	4.25	5.47
	6	4.50	4.68
No	4	10.35	.17
	5	4.58	2.53
	6	1.99	7.34

Relationship Between Change in Classroom Practices and Selected Variables

In addition to the analyses concerned with the relative effectiveness of the four methods of in-service education, data were also analyzed to answer the question:

> What is the relationship of change in teachers' classroom practices to teacher actuarial and personality variables, teacher reaction to the in-service education program, and change in teacher achievement.

Change in classroom practices was determined by subtracting for each teacher the pre-test score from the post-test score for each of the components of the Qualitative and Quantitative Dimensions of the Classroom Practices Interview Instrument. A constant was added to each of these scores to adjust for negative scores obtained. The final scores were then correlated with the variables reported in Table 46.

Significant correlations reported in Table 46 were widely scattered and were usually just large enough to qualify as significant. Among the actuarial factors, High School Mathematics Units were negatively related to change in non-textbook activities, Sex was related to change in the use of non-textbook materials, and the Undergraduate Major was related to change in Organization procedures. Men reportedly changed more than women and the positive correlation with organization indicates that those teachers with undergraduate majors outside of education changed more than did those teachers who majored in education.

Authoritarianism (Christie F) was negatively related to change on the Activities component on the total qualitative score and the number of

TABLE 46

Correlation Coefficients of Changes in Classroom Practices to Actuarial and Personality Factors, Reactions to the In-Service Education Program, and Change in Teacher Achievement for Forty-five Teachers

	Change in Classroom Practices								
	Qualitative						Quantitative		
	Materials	Activities	Organi-zation	Teaching Aids	Evaluation	Total Score	Amount of Discussion	Number of Non-Textbook Activities	Number of Non-Textbook Materials Used
Actuarial Factors									
High School Mathematics Units	.15	—.07	—.12	—.07	.22	.02	—.09	—.29*	—.08
College Mathematics Hours	—.13	.19	—.16	.02	—.08	—.12	.04	—.10	—.24
College Mathematics Methods Hours	—.12	.04	.22	—.02	—.25	—.05	.22	.17	.03
Highest Degree	.03	—.05	—.19	—.11	.05	—.07	—.12	—.05	—.08
Undergraduate Major	—.14	—.03	.30*	.20	.07	.09	.08	.07	.05
Sex	—.29*	—.11	.06	—.25	—.15	—.27	.03	.03	.08
Years of Teaching Experience	—.20	—.07	—.19	—.06	.03	—.19	—.08	—.24	—.15

Personality									
Christie F	—.17	—.33*	—.16	—.07	—.25	—.30*	.06	—.36*	—.15
MTAI	.19	.07	.00	—.07	.17	.16	—.32*	.14	.16
Reaction to In-Service Program									
General	—.09	—.29*	—.31*	.06	—.01	—.18	.05	—.35*	—.24
Usefulness	—.07	—.31*	—.18	.17	.06	—.09	—.07	—.36*	—.25
Written Materials	.05	—.23	—.04	—.02	—.05	—.05	—.17	—.19	—.10
TV or F-F	.15	—.09	.20	.11	.07	.17	—.07	.07	.00
Frequency	—.09	—.08	—.06	—.02	—.09	—.12	—.12	.14	—.03
Extent of Use	—.02	—.19	—.05	.06	—.10	—.10	—.10	—.37	—.26
Change in Teacher Achievement Measures									
Understanding Mathematics Test	.03	—.10	.15	—.14	—.10	—.01	—.19	.29*	.03
STEP—Mathematics, Level 2	.05	—.12	—.19	—.10	—.01	—.09	—.09	—.19	.29*
Mathematics Teaching Tasks	—.11	—.07	—.15	—.02	—.36*	—.22	.09	—.16	—.10

* Significant at the five per cent point.

non-textbook activities reported. The negative correlation indicates that teachers with low authoritarian scores changed more in their practices.

Reaction to the in-service education program was related to change in Activities, in Organization, and in the number of non-textbook activities. Teachers who changed most in these components reacted more favorably than other teachers in general to the in-service education program and to its usefulness.

Change in teacher achievement measures was not consistently related to change in classroom practices as might have been expected. The *Understanding Mathematics Test* was related to change in the number of non-textbook activities; STEP was related to change in the number of non-textbook materials used; and change in evaluation practices was related to *Mathematics Teaching Tasks*.

SUMMARY

Significant changes were made in the classroom practices of elementary teachers involved in the in-service education program reported in this study. Six of the eight components of the interview instrument resulted in significant changes in teachers' classroom practices.

The relative effectiveness of television and face-to-face lecture-discussion media of in-service education was evaluated through the use of an analysis of covariance design planned to answer the following questions:

1. What is the relative effectiveness of television and face-to-face lecture-discussion methods of in-service education in changing the classroom practices of teachers?
2. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the classroom practices of teachers?

Of the nine analyses of covariance, only two of the main effects and one of the interactions were significant. Teachers in the face-to-face lecture-discussion group changed more in their manner of using materials than teachers in the television group; fourth grade teachers changed less than others in the amount of class time devoted to discussion; and several differences were apparent in the interactions among consultant, achievement, and grade groups.

CHAPTER V

Pupil Mathematics Achievement and Interest

THE PROBLEM

One of the basic premises of in-service education is that work with teachers will bring about positive changes in their pupils. The third aspect of this investigation was the study of changes in pupils' mathematics achievement and interest during the in-service education program.[93] Specifically, the following dependent variables were utilized in this evaluation:

A. Change in pupils' achievement in selected aspects of mathematics emphasized in the in-service education series
B. Change in pupils' general mathematics achievement
C. Change in pupils' interest in mathematics

This chapter is organized in five sections. The first section includes a description of the test instruments utilized in this phase of the study, test administration procedures, and the preparation of data for analysis. In the second section, consideration is given to the general effectiveness of the teacher in-service education program as measured by pupil change in

[93] A basic assumption involved in this phase of the study was that the teachers' increased understanding of mathematics content as a result of the in-service education program would be reflected in increased pupil achievement and interest. A few studies of limited scope have been made, which, although inconclusive, tend to support this assumption. Among these studies are the following:

Charles E. Hamilton, "The Growth of Conservation Concepts Among Sixth-, Seventh-, and Eighth-Grade Pupils Under Two Types of In-Service Teacher Education," (unpublished Ph.D. dissertation, University of California, Berkeley, 1956.

Gordon M. A. Mork, "Effects of an In-Service Teacher Training Program on Pupil Outcomes in Fifth and Sixth Grade Science," (unpublished Ph.D. dissertation, University of Minnesota, 1953).

Donald Edward O'Bierne, "Development and Appraisal of a Teacher Education In-Service Program in the Greencastle Public Schools" (unpublished Ph.D. dissertation, Northwestern University, 1950).

C. R. Von Eschen, "The Improvability of Teachers in Service," *Journal of Experimental Education*, XIV (December, 1945), pp. 135–56.

mathematics achievement and interest, while the third section is concerned with the relative effectiveness of the selected methods of in-service education being investigated in the study. Data relative to the extent of relationship between change in pupils' mathematics achievement and interest and selected teacher variables are included in the fourth section. A summary of the findings concludes the chapter.

COLLECTION OF THE DATA

Descriptions of Instruments

Instruments were selected or developed that would measure the specific dependent variables of the study. Test instruments utilized in this portion of the study were:

A. *Test of Mathematics Understanding*
B. *Sequential Tests of Educational Progress—Mathematics*, Level 4
C. *Texas Elementary School Mathematics Interest Inventory*

Test of Mathematics Understanding. To measure change in pupils' achievement in the selected aspects of mathematics emphasized in the in-service education series, the *Test of Mathematics Understanding* was developed. In the development of this instrument the most significant concepts stressed in the in-service education series were identified.[94] More than one hundred multiple-choice items, designed to measure pupil understanding of these significant concepts, were formulated. A preliminary form of the test, composed of these potential test items, was administered to two hundred fourth, fifth, and sixth grade pupils in Beaumont, Texas. An analysis was made of the response pattern of these pupils to each item. Further, pupils' questions and comments concerning each item were recorded during the administration of the test and subsequently analyzed. On the basis of these analyses, test items were deleted or revised.

Utilizing the items thus obtained, two parallel forms, designed to measure the same basic concepts, were prepared. Each form of the revised *Test of Mathematics Understanding* contained thirty-five items. The number of correct responses was used to determine the test score.

A typographical error which invalidated item number nine of Form B occurred during the publication of the test. This item and the corresponding item number nine on Form A were eliminated from the scoring procedure. Thus, in this study, a total of thirty-four items on each of the two forms were used in the analysis.

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[94] These concepts are marked with an asterisk (*) in the list of concepts (Appendix A) for each section of the in-service education program.

No attempt was made to validate the test by comparison with results from other tests of known or assumed validity, there being no test available for this purpose. However, test items were designed specifically to measure the concepts developed in this in-service education series. Further, they were analyzed by a jury composed of a mathematician, a psychologist, and an elementary education professor. The conclusion of the jury was that this test would measure these concepts and that the two forms of the test were comparable.

The reliability of the instrument was computed by the Spearman-Brown split-half reliability formula[95] using the post-test scores of a sample of three hundred ninety-five pupils to determine the reliability of Form A, and of three hundred pupils to determine the reliability of Form B. The reliability coefficients thus determined were .60 for Form A and .70 for Form B.

Sequential Tests of Educational Progress—Mathematics. To measure change in pupils' general mathematics achievement, an instrument was selected that measured broad understandings of basic mathematics concepts rather than one which measured only achievement in specific mathematics skills. The *Sequential Tests of Educational Progress—Mathematics,* Level 4, Forms A and B were used for this purpose.

The STEP-Mathematics, Level 4, Form A yielded a reliability coefficient of .89 with a sample group of fifth grade pupils.[96] Only Form A was analyzed in this reliability test; however, the publisher states that the results should characterize Form B reasonably well since the A and B forms are very similar in content.[97].

One recognized limitation of the instrument was a heavy dependence upon reading skills. This limitation is verified by data in the technical report which indicates that at grade four the correlation of STEP-Mathematics, Level 4 scores with measures of verbal ability is higher (.74) than with measures of quantitative ability (.64).[98] For additional information relative to this instrument, the reader is referred to the discussion of the STEP-Level 2 in Chapter III.

Texas Elementary School Mathematics Interest Inventory. To measure change in pupils' interest in mathematics, the *Texas Elementary School*

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[95] Allen L. Edwards, *Statistical Methods for the Behavioral Sciences* (New York: Rinehart, 1960), pp. 175–77.

[96] Educational Testing Service, Technical Report, *Sequential Tests of Educational Progress* (Princeton, N. J.: Educational Testing Service, 1947), p. 10.

[97] *Ibid.*, p. 9.

[98] *Ibid.*, p. 18.

Mathematics Interest Inventory was developed. In the development of this instrument, pupil activities involving mathematics were identified. To assist in the identification of these activities, pupils themselves were used in a variety of ways. Several classes wrote themes on "My Favorite Day in Arithmetic." Others made up arithmetic problems. A fifth grade class examined an arithmetic text and indicated particular parts which were interesting to them. For one class, a set of 5" × 8" cards was prepared which presented arithmetic puzzles, tricks, and number games. Children worked with this set of cards during free periods in the school day. Later they indicated the most interesting ideas, games, or puzzles. In addition to these activities, discussions concerned with various aspects of mathematics were held with several groups of five or six children. One such discussion was held with an entire class. Individual conferences were held with two boys and two girls from each of several fourth grade classes. A total of over three hundred pupils was involved in this preliminary identification of potential items to be used on the interest inventory.

From this vast array of materials, themes, and discussion notes, ideas for one hundred fifty items were obtained. Each of these items was then carefully evaluated for face validity as an indicator of a pupil's interest in mathematics. Seventy items were selected for inclusion on the preliminary form of the inventory.

The preliminary form of the interest inventory was administered to 354 fourth, fifth, and sixth grade pupils in twelve classes of two elementary schools in Austin, Texas. Responses of these pupils to individual items were analyzed in three ways. First, pupils' questions and comments relative to each item were recorded during the test administration and analyzed. Each item was evaluated for suitable vocabulary and pupil understanding of the listed activity. Eleven of the items were judged unsuitable as a result of this analysis. The second analysis involved the comparison of pupil response to each item with total score on the inventory, yielding an instrument internal consistency check. The responses of pupils in the highest quarter, when ranked by total score were compared with those of pupils in the lowest quarter. Four items which failed to discriminate between these two groups of pupils were deleted from the revised instrument. The third analysis was of the responses of pupils judged most interested in mathematics by their teacher with an equal number of pupils judged least interested in mathematics. The teacher in each of the twelve classrooms identified five pupils in his room who appeared most interested in mathematics and five pupils who appeared least interested in mathematics. A comparison was made of the responses to each item by the sixty pupils who were judged "most interested in mathematics" with the sixty pupils who were judged "least interested in mathematics." Five items did not discriminate between these two groups of pupils and were not included on the revised interest inventory. Thus, a total of twenty items were deleted as a result of these analyses.

Fifty activities were included in the revised *Texas Elementary School Mathematics Interest Inventory*. To each of these activities, pupils responded "I like this activity very much" (value 8), "I like this activity" (value 6), "I dislike this activity" (value 4), "I dislike this activity very much" (value 2). No answer or a mismarked answer was scored 5. Pupils were asked to respond to all items. Although the instrument was untimed, most pupils completed the inventory in twenty minutes or less.

Construct validity was assumed as a result of the methods utilized in the construction of inventory items. The reliability of the instrument was computed by the Spearman-Brown split-half reliability formula[99] using a sample of 659 pupils' pre-test scores. The reliability coefficient thus determined was .57. Although the reliability was low, it was judged sufficient when consideration was given to: (1) the low reliability coefficients of instruments of a similar nature, and (2) the age of the pupils responding to the instrument.

Administration of Test Instruments

The tests previously described were administered to pupils between October 3 and October 9, 1960, which was prior to the first teacher in-service education meeting. After the last in-service education meeting, post-tests were administered (April 17–24, 1961).

Each class was tested in two 90-minute periods. During the first period, the *Sequential Tests of Educational Progress—Mathematics*, Level 4 was administered. This test was administered in two 35-minute parts. The second testing period was scheduled for one day later. During the second testing period the *Test of Mathematics Understanding* was administered during the first forty minutes of the period followed by the *Texas Elementary School Mathematics Interest Inventory*.

Two forms of the *Sequential Tests of Educational Progress—Mathematics* (Form 4A and 4B) and the *Test of Mathematics Understanding* (Forms A and B) were used. In the pre-tests, an approximately equal number of classes in each research group was administered Form A and

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[99] Edwards, *loc. cit.*

From B of these tests. During the post-testing those classes that took Form A on the pre-test were administered Form B; and those classes that took Form B on the pre-test were administered Form A.

The tests were administered to pupils by eighteen substitute teachers. Every precaution was taken to insure uniformity in timing and test administration. These examiners received one full day of orientation at the beginning of the pre-test series and one-half day of orientation at the beginning of the post-test series. Orientation sessions included (1) general instructions in the administration of tests, (2) detailed instructions regarding the testing procedures of this study, (3) an examination of the specific tests to be administered, and (4) simulated practice in the administration of these tests.

Preparation of Data for Analysis

More than 3,000 pupils participated in one or more phases of the testing program for this investigation. Some of these pupils did not complete the entire testing program because of absence from school or change in school or room assignment during the school year. Others were in classes other than the eighty-nine included in the final analysis. As the investigation involved the study of change in mathematics achievement and interest, only data for those pupils who had completed both the pre- and the post-tests of all three instruments utilized in the study were included in the analysis. In the eighty-nine classes, 1,977 pupils completed all phases of the testing program. The final analysis is based on data from these pupils.

Two complicating factors were involved in the analysis of data. First, the number of pupils per class who completed all phases of the testing program varied widely, with as few as eight pupils in one class to as many as thirty-two in another. Second, the eighty-nine classes included in the study were disproportionately distributed among the research groups, with the number of classes per group ranging from two to five.

Two alternatives were considered by the investigators in determining the treatment of these complicating factors. The first involved the elimination of cases to equalize frequencies within each research group. This procedure would have resulted in the loss of over one-half of the cases for whom complete data were available. The second alternative considered and subsequently adopted involved the use of class mean scores in an analysis of covariance statistical technique which would treat unequal numbers of class means among research groups. By choosing the second alternative, unnecessary loss of data was avoided.

GENERAL EFFECTIVENESS OF THE IN-SERVICE EDUCATION PROGRAM

To evaluate the general effectiveness of the teacher in-service education program, test means and standard deviations were computed from the pre- and post-measures for all pupils included in the study. To determine the significance of the change between pre- and post-tests, *t*-tests were computed. These analyses are summarized in Table 47.

TABLE 47

Pre- and Post-Test Descriptions of the Mathematics Achievement and Interest of Pupils in Eighty-Nine Classes

Variable	Pre-Test		Post-Test		Change		t	p
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
Test of Mathematics Understanding	12.40	2.16	15.09	3.21	2.69	1.05	13.45	<.01
Sequential Test of Educational Progress—Mathematics, Level 4	229.56	6.39	233.96	8.61	4.40	.22	12.88	<.01
Texas Elementary School Mathematics Interest Inventory	289.64	15.90	288.78	18.66	—.86	2.76	.43	

On the *Test of Mathematics Understanding*, which was designed to evaluate achievement in specific concepts of mathematics related to the in-service education series, the pre-test mean score was 12.40, while the post-test mean was 15.09. During the teacher in-service education program, pupils made a positive change of 2.69 between means. A *t*-test[100] was computed to determine if this gain was statistically significant. With a *t* of 13.45 and 88 degrees of freedom, this difference was significant at the one per cent point. Gains made by pupils on this instrument during the teacher in-service education program were significant. There was a wider dispersion of scores at the conclusion of the in-service education program than at its beginning as indicated by a larger post-test standard deviation (3.21) than that which was found on the pre-test (2.16).

Pupils' general mathematics achievement was measured by the *Sequential Tests of Educational Progress—Mathematics*, Level 4 (STEP). A positive change of 4.40 between means was achieved by pupils in the study during the teacher in-service education program; with a pre-test mean of 249.56 and a post-test mean of 253.96. The *t* of 12.88 with 88 degrees of freedom indicated that this difference was statistically significant at the one per cent point. The larger standard deviation among post-test measures (8.61) than pre-test measures (8.39) indicated a wider dispersion of scores at the end of the in-service education program than at its beginning.

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[100] Walker and Lev, *loc. cit.*

Pupils made a slight negative change (—.86) between means on the mathematics interest inventory. The pre-test mean was 289.64 and the post-test mean was 288.78. The *t*-test indicated that this change was not significant. There was a wider dispersion of scores on the post-test than on the pre-test as indicated by a larger standard deviation.

Results of the testing program indicated that pupils as a total group made significant positive changes between the pre- and post-tests in achievement on the specific concepts emphasized in the teacher in-service education series and in overall general mathematics achievement. It is important to note this significant difference between pre- and post-scores. In most of the analyses presented later in the chapter no differences are reported among the four in-service education methods even though all groups or the combination of all groups did change significantly. However, it is to be noted that no significant change occurred during the teacher in-service education program relative to pupils' interest in mathematics as measured by the instrument utilized in the study.

RELATIVE EFFECTIVENESS OF FOUR METHODS OF IN-SERVICE EDUCATION

The relative effectiveness of the four methods of teacher in-service education was tested through the analysis of covariance statistical technique. Independent variables included in the research design of this aspect of the investigation included:

A. *In-Service Presentation Media*—Television versus face-to-face lecture-discussion
B. *Consultant*—Yes or no
C. *Grade Level*—Four, five, or six
D. *Class Achievement Grouping*—High achievement grouped classes versus heterogeneously grouped classes

Specifically, four questions were asked which were related to this phase of the investigation.

A. What is the relative effectiveness of television and lecture-discussion as media of in-service education in changing the mathematics achievement of pupils of participating teachers?

B. What is the relative effectiveness of television and lecture-discussion as media of in-service education in changing the mathematics interests of pupils of participating teachers?

C. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the mathematics achievement of pupils of participating teachers?

D. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the mathematics interests of pupils of participating teachers?

Selection of Control Variables Utilized in the Analyses

To isolate pupil change in mathematics achievement and interest attributable to the various teacher in-service education methods under investigation, selected teacher variables which might influence results were identified and controlled. In the initial assignment of teachers and their classes, research groups were balanced as nearly as possible on two criteria. These two factors were (1) teacher experience and (2) socioeconomic level of the school community. Other factors which appear to be related to teacher's mode of operation had been identified in studies by DeVault and others,[101] Anderson,[102] and Ryans.[103] Teacher characteristics which were selected and utilized as potential variables to be statistically controlled were discussed in Chapter II and are listed in Table 2.

To determine the extent to which the potential control variables were related to pupil mathematics achievement and interest, each in turn was correlated with pupils' pre- and post-test scores. The extent of these relationships are indicated in the correlation matrix presented in Table 48.

The correlation coefficient of the pre- with the post-scores on the *Test of Mathematics Understanding* was .81. The pre- with post-test correlation coefficient for the STEP was .94, while the pre-measures on the mathematics interest inventory were correlated at .48 with the post-measures. All three correlations were significant at the one per cent point. Each pre-test variable was utilized as a control variable with its appropriate

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[101] DeVault, M. Vere, and Others, *An Exploratory Study of Intraclass Instructional Grouping* (Austin, Texas: Department of Curriculum and Instruction, 1958).

[102] Anderson, Harold H., and Helen M. Brewer, *Studies of Teacher's Personalities: I Dominative and Socially Integrative Behavior of Kindergarten Teachers.* Applied Psychology Monographs No. 6. (Stanford, California: Stanford University Press, 1945), 157 p.

[103] Ryans, *loc. cit.*

TABLE 48

Correlation Coefficients Obtained for Pupil Achievement and Interest with Potential Control Variables for Pupils in Eighty-Nine Classes

Variable	Pupil Measures					
	Mathematics Understanding		STEP, Level 4		Mathematics Interest Inventory	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Pupils						
Mathematics Understanding (Pre)	1.00	.81†	.87†	.87†	.05	—.10
STEP, Level 4 (Pre)			1.00	.94†	—.04	—.11
Mathematics Interest Inventory (Pre)					1.00	.48†
Teachers						
Actuarial Factors						
High School Mathematics Units	.01	—.09	.00	—.05	—.08	—.13
College Mathematics Hours	—.18	—.15	—.22*	—.18	.18	.11
College Mathematics Methods Hours	—.10	—.12	—.13	—.12	—.08	—.02
Highest Degree	.10	.09	.12	.13	—.11	—.17
Understanding Major	—.02	—.15	—.02	—.02	—.18	—.17
Sex	.10	.19	.12	.21*	.00	—.03
Years of Teaching Experience	.02	—.02	—.02	.02	.05	—.05
Personality						
Christie F	—.07	—.15	—.09	—.03	—.10	.02
MTAI	.01	.08	—.05	—.04	.09	.12
Achievement Measures						
Mathematics Understanding (Pre)	—.09	—.09	—.10	—.10	—.14	—.13
STEP, Level 2 (Pre)	.15	.14	.17	.16	.09	.17
Mathematics Teaching Tasks (Pre)	.07	.18	.07	.08	—.05	.02

* Significant at the five per cent point.
† Significant at the one per cent point.

post-test variable in the analysis of covariance. In effect this equated all classes on the pre-test variables, while allowing the adjusted post-test scores to vary. None of the identified teacher characteristics were utilized as control variables, inasmuch as there were no marked patterns of relationships which indicated that these variables were significantly related to the pupil scores on the dependent variables of the study.

Achievement in Selected Aspects of Mathematics Emphasized in the In-Service Education Series

The *Test of Mathematics Understanding* was utilized in the study to measure pupils' achievement in those selected aspects of mathematics which were stressed in the teacher in-service education series. The analysis of covariance for these scores is presented in Table 49. One interaction was statistically significant, the interaction of consultant and class achievement grouping (CA).

TABLE 49

Analysis of Covariance of Pupils' Post-Test Mathematics Understanding Scores with Adjustment for Pre-Test Scores

Source of Variance	df	Adjusted Sum of Squares	Adjusted Mean Square	F	P
Presentation (P)	1	10.56	10.56	1.913	
Consultant (C)	1	20.02	20.02	3.629	
Grade (G)	2	14.56	7.28	1.320	
Achievement (A)	1	14.87	14.87	2.695	
PC	1	.20	.29	.037	
PG	2	1.75	.87	.159	
PA	1	.91	.91	.164	
CG	2	11.39	5.69	1.032	
CA	1	24.62	24.62	4.463	$<.05$
GA	2	7.86	3.93	.712	
PCG	2	26.90	13.45	2.438	
PCA	1	14.68	14.68	2.661	
PGA	2	16.15	8.08	1.464	
CGA	2	7.87	3.93	.713	
PCGA	2	2.21	1.10	.200	
Error	64	353.09	5.12		

The adjusted parameter estimates which were obtained from the analysis of covariance have little relationship to the raw score units of the original measure. By definition, their sum must be zero. They do, however, indicate the relative effectiveness of the various factors evaluated in the analysis of covariance.

At each grade level in all schools utilized in the study, it was the policy of the school system to assign pupils with the highest overall achievement to one class while all other pupils were heterogeneously grouped in the remaining sections of that grade level. Differences between the classes thus assigned were evaluated by the independent variable, class achievement grouping (A). Differences between the high achievement classes with and without consultant services and the heterogeneously grouped classes with and without consultant services were evaluated by the interaction CA. The adjusted parameter estimates for the interaction CA are presented in Table 50. These parameter estimates indicate that for high achievement classes the presence of a consultant was not related to change in mathematics achievement. However, in the heterogeneously grouped classes, the classes of consultant-served teachers changed significantly more than the classes of non-consultant teachers.

TABLE 50

Adjusted Parameter Estimates in the Analysis of Covariance for Mathematics Understanding Scores of Eighty-Nine Classes by Consultant and Class Achievement Grouping (CA)

Consultant (C)	Class Achievement Group (A)	
	High Achievement	Heterogeneous
Yes	46.29	52.35
No	57.13	—155.77

To summarize, no difference was found in the change in pupils' achievement in selected aspects of mathematics emphasized in the in-service education series between the television and the face-to-face lecture-discussion groups. Likewise, the difference between consultant and non-consultant groups was not significant. However, there was a significant difference between consultant-served heterogeneous classes and non-consultant heterogeneous classes which favored the consultant group.

General Mathematics Achievement

The *Sequential Tests of Educational Progress—Mathematics*, Level 4 was utilized in the study to measure pupils' general mathematics achievement. The analysis of covariance for these scores is presented in Table 51. Of the fifteen main effects and interactions of the analysis, three were statistically significant at the five per cent point—in-service presentation media (P), the interaction of in-service presentation media and consult-

TABLE 51

Analysis of Covariance of Pupils' Post-Test General Mathematics Achievement Scores with Adjustment for Pre-Test Scores

Source of Variance	df	Adjusted Sum of Squares	Adjusted Mean Square	F	P
Presentation (P)	1	11.37	11.37	4.090	$<.05$
Consultant (C)	1	8.18	8.18	2.942	
Grade (G)	2	2.33	1.16	.419	
Achievement (A)	1	6.22	6.22	2.238	
PC	1	19.93	19.93	7.168	$<.05$
PG	2	11.15	5.58	2.005	
PA	1	2.26	2.26	.812	
CG	2	.05	.03	.010	
CA	1	1.22	1.22	.439	
GA	2	31.08	15.54	5.589	$<.05$
PCG	2	5.19	2.60	.934	
PCA	1	3.71	3.71	1.336	
PGA	2	13.35	6.68	2.401	
CGA	2	12.82	6.41	2.304	
PCGA	2	3.65	1.83	1.314	
Error	64	177.94	2.78		

TABLE 52

Adjusted Parameter Estimates in the Analysis of Covariance for General Mathematics Achievement Scores of Eighty-Nine Classes by In-Service Presentation Media (P)

Presentation (P)	Adjusted Parameter
Television	.38
Face-to-Face Lecture-Discussion	—.38

ant (PC), and the interaction of grade and class achievement grouping (GA).

The adjusted parameter estimates for the main effect in-service presentation media (P) are presented in Table 52. Although these adjusted parameter estimates have little direct relationship to the converted scores of the STEP test, they do indicate the relative changes made by the television and face-to-face lecture-discussion groups. The results reported in Table 52 indicate that the television group changed significantly more than the face-to-face lecture-discussion group in their general mathematics achievement during the teacher in-service education program.

The interaction of in-service presentation media and consultant (PC) was significant at the five per cent point. The adjusted parameter estimates for this interaction are included in Table 53. Pupils in the television group whose teachers also had the services of a consultant available made greater gains than those pupils whose teachers did not have a consultant available. However, in the face-to-face lecture-discussion group, classes of consultant-served teachers did not make as much change between pre- and post-tests as the non-consultant classes.

TABLE 53

Adjusted Parameter Estimates in the Analysis of Covariance for General Mathematics Achievement Scores of Eighty-Nine Classes by In-Service Education Method (PC)

	Consultant (C)	
Presentation (P)	Yes	No
Television	.56	.20
Face-to-Face Lecture-Discussion	—1.20	.44

The interaction of grade and class achievement grouping (GA) was significant at the five per cent point. The adjusted parameter estimates for this interaction are presented in Table 54. In the fourth and fifth grades, the high achievement group made greater gains than the heterogeneously grouped classes. However, in the sixth grade, the heterogeneous group made greater gains than did the high achievement group. This probably is a reflection of the greater pre-test scores of the sixth grade high achievement group than the other groups and the practical limitations of the instrument in measuring the growth of the group.

TABLE 54

Adjusted Parameter Estimates in the Analysis of Covariance for General Mathematics Achievement Scores of Eighty-Nine Classes by Grade and Class Achievement Grouping (GA)

	Achievement (A)	
Grade (G)	High Achievement	Heterogeneous
4	1.15	—.95
5	.35	—.83
6	—.24	.52

In summary, pupils in the television group changed more than pupils in the face-to-face lecture-discussion group in general mathematics achievement. When the data were analyzed by consultant and in-service presentation media (PC), the face-to-face lecture-discussion non-consultant group made the least change of any of the groups. There was a difference in change, favoring the television-consultant group over the television non-consultant group; however, the face-to-face lecture-discussion group without a consultant was favored over the consultant group.

Interest in Mathematics

The *Texas Elementary School Mathematics Interest Inventory* was utilized in the measurement of change in pupils' interest in mathematics. The analysis of covariance for this criterion measure is presented in Table 55. There were no significant differences between groups as measured by this instrument.

RELATIONSHIP OF PUPIL CHANGE IN MATHEMATICS UNDERSTANDING AND INTEREST TO SELECTED TEACHER VARIABLES

Pupil data were further analyzed to determine the extent of relationship between change in pupils' mathematics achievement and interest

TABLE 55

Analysis of Covariance of Pupils' Post-Test Mathematics Interest Scores with Adjustment for Pre-Test Scores

Source of Variance	df	Adjusted Sum of Squares	Adjusted Mean Square	F	P
Presentation (P)	1	18.17	18.17	.058	
Consultant (C)	1	620.17	620.17	1.980	
Grade (G)	2	777.65	388.83	1.242	
Achievement (A)	1	200.51	200.51	.640	
PC	1	61.67	61.67	.197	
PG	2	436.80	218.40	.697	
PA	1	200.21	200.21	.639	
CG	2	322.06	161.03	.514	
CA	1	34.01	34.01	.109	
GA	2	92.35	46.18	.147	
PCG	2	503.39	251.17	.802	
PCA	1	76.40	76.40	.244	
PGA	2	53.27	26.64	.085	
CGA	2	42.57	21.28	.068	
PCGA	2	11.06	5.53	.018	
Error	64	20037.85	313.09		

and selected teacher variables. Specifically, these analyses were computed to study the following question:

> What is the relationship of change in pupils' understanding of and interest in mathematics to teacher actuarial and personality variables, teacher reaction to the in-service education program, change in teacher achievement, and change in classroom practices?

Change in pupils' mathematics achievement and interest during the teacher in-service education program was computed by subtracting pre-test scores from respective post-test scores. These derived measures were then correlated with selected teacher variables to determine the extent of relationship. Correlation coefficients thus determined are presented in Table 56.

TABLE 56

Correlation Coefficients Obtained for Change in Pupil Achievement Scores and Selected Teacher Variables for Eighty-Nine Teachers and Their Classes

	Pupil Change Variables		
Teacher Variables	Test of Mathematics Understanding	STEP Level 4	Mathematics Interest Inventory
Actuarial Factors			
High School Mathematics	—.16	—.22	—.06
College Mathematics Hours	.20	—.04	—.04
College Mathematics Methods Hours	—.05	—.33†	—.05
Highest Degree	.00	—.06	.11
Undergraduate Degree	.06	.11	—.04
Sex	.15	.20	.10
Years Teaching Experience	.08	—.15	.27*
Personality			
Christie F	.05	—.11	—.10
MTAI	—.22*	—.01	.11
Change in Achievement			
Understanding Mathematics Test	.29†	.02	.08
STEP, Level 2	.00	—.03	—.12
Mathematics Teaching Tasks	—.04	.10	.09
Reaction to In-Service Program			
General reaction	—.07	.03	.09
Usefulness of program	—.18	—.10	—.02
Reaction to written materials	—.08	.09	.01
Reaction to TV or F-F	.06	.00	—.11
Reaction to frequency of programs	.07	.03	.11
Extent of use of materials	—.31†	—.03	—.05

* Significant at the five per cent point.
† Significant at the one per cent point.

A correlation coefficient of −.33 was obtained for the relationship of change on the STEP, Level 4 to number of hours of college mathematics methods. This correlation, significant at the one per cent point, indicated that, for this population, greater change on the STEP, Level 4 during the in-service education program tended to be made by the pupils whose teachers had fewer hours of college mathematics methods. The number of years of teaching experience was positively related to change in mathematics interest of pupils during the in-service education program.

A negative correlation was obtained between teachers' scores on the MTAI, a test of authoritarianism, and pupils' change on the *Test of Mathematics Understanding*, indicating that pupils of more permissive teachers made the greater gains.

A correlation coefficient of .29 was obtained for the relationship of change in pupils' scores on the *Test of Mathematics Understanding* and change in teachers' scores on the *Understanding Mathematics Test*. This correlation, significant at the one per cent point, indicated that the greatest changes in pupil achievement which was most directly related to the in-service education program were made in those classes whose teachers had made the greatest changes in that area.

The extent of use of materials from the in-service education program was positively related to change in pupil achievement on the *Test of Mathematics Understanding*. The correlation coefficient of .31, which was significant at the one per cent point, indicated that the greatest changes were made by pupils whose teachers most extensively used ideas and materials included in the in-service education program.

SUMMARY OF ANALYSES OF PUPIL DATA

During the teacher in-service education program, significant gains were made by pupils in general mathematics achievement and in mathematics understandings directly related to the in-service education series. No significant change was made by pupils in interest in mathematics during this period.

The relative effectiveness of television and face-to-face lecture-discussion as media of teacher in-service education was evaluated through the analysis of data relative to the first two questions related to this aspect of the study. These questions were:

> A. What is the relative effectiveness of television and lecture-discussion as media of in-service education in changing the mathematics achievement of pupils of participating teachers?

B. What is the relative effectiveness of television and lecture-discussion as media of in-service education in changing the mathematics interests of pupils of participating teachers?

No difference was found in the relative effectiveness of television or face-to-face lecture-discussion as measured by the first dependent variable, change in pupils' achievement in selected aspects of mathematics emphasized in the in-service education series. However, there was a significant difference which favored television when evaluated by the second dependent variable, change in pupils' general mathematics achievement. There was no difference between these two media in change in pupils interest in mathematics, as evaluated through the third dependent variable.

The effectiveness of the consultant when used as a supplement to television or face-to-face lecture-discussion was evaluated through an analysis of data relative to two questions which were:

A. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the mathematics achievement of pupils of participating teachers?
B. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the mathematics interests of pupils of participating teachers?

When evaluated by the first dependent variable, change in pupils' achievement in selected aspects of mathematics emphasized in the in-service education series, a significant difference was found between the heterogeneous classes with a consultant and those without a consultant, favoring the consultant group. No such difference was found between the consultant and non-consultant high achievement classes.

With the second dependent variable, change in pupils' general mathematics achievement, significant differences were found in the interaction of in-service presentation media and consultant. There was a difference in pupil change on this variable favoring the television-consultant group over the television non-consultant group; however, the face-to-face lecture-discussion non-consultant group made greater gains than did the face-to-face lecture-discussion consultant group.

The third dependent variable, change in pupils' interest in mathematics, was utilized in evaluating the second question listed above. No difference was found between consultant and non-consultant groups as measured by this criterion measure.

CHAPTER VI

Summary, Conclusions and Implications

SUMMARY

Problem and Procedures

The problem of this study was to determine the relative effectiveness of television, television supplemented by classroom consultant services, face-to-face lecture-discussion, and face-to-face lecture-discussion supplemented by consultant services as methods of in-service education for elementary school teachers. The relative effectiveness of the four methods of in-service education was evaluated in terms of change in teacher achievement, change in teachers' classroom practices, and change in pupil achievement and interest.

One hundred two teachers of elementary school mathematics in grades four, five, and six in one school system volunteered to participate in the study. Eighty-nine teachers who completed all phases of the program, including pre- and post-testing and their classes, constitute the population of this study. Background information was collected from the teachers on a Background Information Registration Form early in September, 1960. The population was then divided into four in-service education groups on the basis of the following three criteria: (1) their proximity to a centralized location for a face-to-face lecture-discussion series, (2) years of teaching experience, and (3) socio-economic level of the school community. Approximately half (49) of the teachers participated in an in-service education program presented via television while the remainder (40) participated in a face-to-face lecture-discussion in-service education series. Consultant services were made available to approximately half of the teachers in the television group and to half of the teachers in the face-to-face lecture-discussion group. Two consultants spent a total of forty-eight days with the forty-three teachers in the consultant groups.

Content for the in-service education program was determined by the specialized teaching area of the teachers in the program. A research team from The University of Texas prepared written materials related to modern concepts of mathematics for elementary school teachers. These materials were distributed to all four in-service education groups. Television script was then prepared with the written materials as the source of content. Twenty-four 30-minute videotapes were then prepared. A mathematics professor from The University of Texas was the instructor in this series of videotapes. The television series was presented to the in-service teachers by KERA-TV, Channel 13. One 30-minute program was telecast on each Tuesday that school was in session from 4:00–4:30 p.m. during the 1960–1961 school year.

The same professor of mathematics was the instructor in both television and face-to-face lecture-discussion series. Content for both series was based on the same written materials. Twelve one-and-one-half-hour face-to-face lecture-discussion sessions were held bi-weekly on Tuesday from 4:30–6:00 p.m. during the 1960–1961 school year.

The role of the consultants was to assist the classroom teachers in finding effective ways of relating new ideas to actual classroom instructional procedures. The services of the consultants included assistance in analyzing instructional problems, developing activities or programs leading to the possible solution of identified problems, and assistance in clarifying new concepts presented in the in-service education series.

All testing was done in early October and again late in April. Tests were machine scored and data were processed for machine operation. The analysis of covariance was the major statistical procedure used for the final analysis of the data.

Results

The two hypotheses of the study were tested in several ways. Change in achievement of teachers, teacher reactions to the in-service education program, change in teachers' classroom practices, and change in pupils' achievement and interest in mathematics were measures used as determiners of the relative effectiveness of the in-service education program. This summary of results is organized in terms of the hypotheses of the study and the specific questions related to these hypotheses.

Hypothesis Number One.

> There is no difference in the effectiveness of television and face-to-face lecture-discussion as media for in-service education of intermediate grade teachers of mathematics.

1. What is the relative effectiveness of television and face-to-face lecture-discussion as media of in-service education in changing the mathematics understanding of teachers?

Notwithstanding the fact that significant gains were made by the total group in both measures of mathematics understanding which were used in this study, television and face-to-face lecture-discussion media were of equal effectiveness in changing the mathematics understandings of teachers in this study.

2. What is the relative effectiveness of television and face-to-face lecture-discussion as media of in-service education in changing teachers' understandings of selected aspects of mathematics teaching method?

Teachers in this study made significant gains on the paper-and-pencil tests used to measure understanding of selected aspects of mathematics teaching methods. Nonetheless, television and face-to-face lecture-discussion were equally effective in bringing about this change.

3. What is the relative effectiveness of television and face-to-face lecture-discussion as methods of in-service education as determined by teachers' reactions to the in-service education program?

Teachers' reactions to the in-service education program did not differ significantly among the television and the face-to-face lecture-discussion groups. Television was thought by teachers to be as useful, as effective, and was rated as well as face-to-face lecture-discussion methods.

4. What is the relative effectiveness of television and face-to-face lecture-discussion methods of in-service education in changing the classroom practices of teachers?

Several measured aspects of classroom teaching practice changed significantly during the time of the in-service education program. In one of these aspects, the manner in which the teacher used instructional materials, the face-to-face lecture-discussion teachers at the end of the in-service education program had changed more significantly toward teacher-centered approaches than had television teachers whose methods in terms of use of materials remained more text-centered.

5. What is the relative effectiveness of television and face-to-face lecture-discussion methods of in-service education in changing the mathematics achievement of pupils of participating teachers?

Pupils made significant gains over the period of the in-service education program on both measures of mathematics achievement. Television and face-to-face lecture-discussion methods were equally effective in changing pupil achievement on that measure which was most directly related to the content taught in the in-service education program. On the test of general mathematics achievement, however, the television group made significantly greater gains than did pupils of the face-to-face lecture-discussion teachers.

6. What is the relative effectiveness of television and face-to-face lecture-discussion methods of in-service education in changing the mathematics interests of pupils of participating teachers?

No measurable gains in interest of pupils in mathematics were made during the period of the in-service education program, and likewise, there were no differences between the television and the face-to-face lecture-discussion methods of presentation on promoting the mathematics interest of pupils.

Hypothesis Number Two.

> There is no difference in the effectiveness of in-service education programs presented by television or face-to-face lecture-discussion which are supplemented with consultant services as compared to those in-service education programs without such consultant services.

1. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the mathematics understandings of teachers?

The mathematics understandings of teachers which were measured by paper-and-pencil tests were not enhanced by supplementary consultant services beyond that provided by the television or face-to-face lecture-discussions methods alone.

2. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing teachers' understandings of selected aspects of mathematics teaching method?

Teachers' understandings of mathematics teaching method were equally improved among groups of teachers with or without consultant services.

3. Are consultant services as a supplement to television or face-to-face lecture-discussion effective as determined by teachers' reactions to the in-service education program?

There was a general tendency for those teachers with whom a consultant worked to react more favorably to various aspects of the in-service education program than those teachers without consultant services. This difference appeared to be more apparent among television teachers than among face-to-face lecture-discussion teachers. The television-consultant teachers reported significantly greater classroom use of the materials and information of the in-service education program than did teachers in the television-only group.

4. Are consultant services as a supplement to television or face-to-face

lecture-discussion effective in changing the classroom practices of teachers?

Although several aspects of classroom practices of teachers changed significantly during the period of the in-service education program, teachers with supplementary consultant services did not make significantly greater changes than did those teachers without such services.

5. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the mathematics achievement of pupils of participating teachers?

Pupils in heterogeneously grouped classes whose teachers had consultant services made significantly greater gains than pupils in heterogeneously grouped classes whose teachers were without consultants in that aspect of mathematics achievement most closely related to the content of the in-service education program. In the area of general mathematics achievement (STEP), the addition of consultant services to television and face-to-face lecture-discussion media did not result in greater achievement for pupils.

6. Are consultant services as a supplement to television or face-to-face lecture-discussion effective in changing the interests of pupils of participating teachers?

No significant gains in pupil interest in mathematics were made during the period of the in-service education program and the addition of consultant services did not result in significantly different post-test measures of interests of pupils.

Several questions in addition to those directly related to the hypotheses of the study were investigated. These questions and a summary of results related to them follow:

1. What is the relationship of change in teacher achievement to teacher actuarial and personality variables?

The only significant relationship between teacher achievement and actuarial and personality variables was a correlation of .25 between *Mathematics Teaching Tasks* and authoritarianism as measured by the Christie F scale.

2. What is the relationship of teacher reaction to the in-service education program to change in teacher achievement and teacher actuarial and personality variables?

Authoritarianism was the only variable related to teacher reactions to the in-service education program. Teachers low in authoritarianism reacted significantly more favorably than high authoritarian teachers to the general aspects of the in-service education program, to the usefulness of the program, and to the television or face-to-face lecture-discussion aspects of the program.

3. What is the relationship of change in teachers' classroom practices to teacher actuarial and personality variables, teacher reaction to the in-service education program, and change in teacher achievement?

Authoritarianism as measured by the Christie F scale was significantly related to change in three of the nine components of the dimensions of classroom practices. These included change in Activities, Total Score on the Qualitative Dimension, and change in the number of non-textbook activities.

Teachers' general reaction to the in-service education series was also related to change in three of the nine components of classroom practices. Teachers who changed most reacted more favorably than teachers who reportedly made less change in their classroom practices.

Other than authoritarianism and reactions to the in-service education program, significant correlations were scattered and at the five per cent point. Apparently no particular significance for the problems of this study may be attached to them.

4. What is the relationship of change in pupils' understanding of and interest in mathematics to teacher actuarial and personality variables, teacher reaction to the in-service education program, change in teacher achievement, and change in classroom practices?

Three variables were significantly related to change in pupil achievement on the *Test of Mathematics Understanding*. These variables were (1) MTAI, (2) teacher change in the companion test, the *Understanding Mathematics Test*, and (3) the reaction to the in-service program in terms of extent of use of materials. These correlations indicate that pupils changed most when in classes where teachers tended to be most permissive (MTAI), where teachers' understandings were also changing (*Understanding Mathematics Test*), and where teachers reported the greatest use of the materials of the in-service education program.

5. To what extent does the effectiveness of the in-service education program differ among fourth, fifth, and sixth grade pupils?

In none of the measures used with pupils were there significant differences from grade to grade. At each grade pupils made significant gains in mathematics achievement on both instruments used in this study. Apparently the content of the program as adapted and used by teachers in their classrooms was equally appropriate for pupils at the various grade levels.

6. To what extent does the effectiveness of the in-service education pro-

gram differ among pupils in heterogeneous and in high achievement classes?

The achievement measures used with pupils in this study resulted in only one significant finding relative to type of class. Heterogeneous classes made significantly greater gains when their teachers had consultant services than when their teachers were without such services. This would indicate that in high achievement classes results were the same with or without consultant but that the consultant was of assistance in promoting pupil achievement among the heterogeneous classes.

CONCLUSIONS

Conclusions drawn from the results of this study follow. First, television was as effective as face-to-face lecture-discussion in changing the mathematics and methods understandings of teachers, in the reactions of teachers to the in-service education program, in changing all but one of nine components of the classroom practices of teachers, and in changing the mathematics achievement and interest of pupils in classes of participating teachers. Second, consultant services as a supplement to television and face-to-face lecture-discussion made a significant contribution in some situations. That is, consultant services resulted in more favorable reactions from television teachers; they resulted in greater mathematics achievement among heterogeneous pupils; and they resulted in greater general mathematics achievement of pupils of television teachers but not of pupils of face-to-face lecture-discussion teachers.

Thus, hypothesis number one: There is no difference in the effectiveness of television and face-to-face lecture-discussion as media for in-service education of intermediate grade teachers of mathematics—*is accepted*.

Hypothesis number two: There is no difference in the effectiveness of in-service education program presented by television or face-to-face lecture-discussion which are supplemented with consultant services as compared to those in-service education program without such consultant services—*is rejected*.

IMPLICATIONS FOR IN-SERVICE EDUCATION AND FURTHER RESEARCH

Limitations of the Study Affecting Implications

A study of in-service education in the public schools necessarily entails various limitations. Before drawing implications from the present study for in-service education and for further research, it is pertinent to point out limitations in the following three categories: (1) limitations related to the population of this study, (2) limitations related to the research procedures, (3) limitations related to the type of consultant services offered, and (4) limitations related to the personnel involved in the in-service education program.

Limitations related to the population of the study. A single school system in a large urban city was used in the study. While the use of one school system had many advantages from a research viewpoint, generalizations concerning the results and conclusions must be tempered in view of the fact that the system used for the study had certain characteristics, which, while not unique, were unusual enough to be considered as limitations in drawing implications from the study. The system's elementary schools were organized upon a platoon plan. Teachers, for the most part, viewed themselves as specialized mathematics instructors. Each had volunteered to participate in the teacher in-service education program. Fourth, fifth, and sixth grade classes of these mathematics teachers constituted the population of the study. Since the study was limited to one school system, and to intermediate grade mathematics classes of volunteer in-service teachers within that system, all the limitations accompanying a limited scope are present. The study is limited by the extent to which the population represents regional and local sets.

Limitations related to research procedures. Although the testing program was as extensive as practicable in an in-service education study, it is recognized that broader and more intensive testing would have resulted in a more extensive evaluation of the hypotheses and related problems of the study. Further, the extent to which the instruments adequately measured the effects of the in-service program must be considered as one kind of limitation. The instruments used in the study have the inherent limitations of paper and pencil tests and interview instruments.

Limitations related to the type of consultant services offered. Consultant services of this study were limited to those which served the *expressed needs* of teachers. There was no attempt made to focus the efforts of the classroom consultants in any preconceived direction. Thus, contacts with teachers were prompted by a variety of questions which ranged from matters of specific mathematics understanding to concerns for general individual professional growth. Meeting individual differences of pupils, classroom organization procedures, and use of textbooks and instructional aids were all legitimate subjects for discussion during teacher-consultant contacts. Had the consultant help been directed specifically and solely to the mathematics content of the television or face-to-face lecture-discussion presentations, the results of the classroom consultant phases of this study might well have been different. Therefore, implications of this study are based only on the specific type of classroom consultant services herein defined.

Limitations related to personnel. A final limitation recognized is that of the personnel involved in implementing the four methods of in-service education. The presentation by television and face-to-face lecture-discussion was made by one instructor. Whatever limitations he had as an instructor are inherently limitations of this study. Consultant services were rendered by two consultants and their limitations are also inherent in this study.

Implications for In-Service Education

An in-service education program for teachers that is carefully planned for specific purposes does change teacher achievement, teacher classroom practices, and pupil achievement and interest. The present study illustrated four ways that can be used effectively in an in-service education program. Apparently, a variety of ways of working with teachers are effective in increasing the understanding of teachers and pupils in a particular subject area.

Inasmuch as a variety of methods may be equally effective in bringing about desired changes, the method most efficient and expedient should be utilized. One method which school systems will want to consider carefully is the use of educational television. The results of this study have indicated that there is no difference in the effectiveness of television and face-to-face lecture-discussion as in-service education media for increasing pupil understanding of mathematics. This finding is consistent with finding of previous studies which have investigated television as a medium of instruction in areas other than in-service education. Considering the flexibility of the medium and its ever-increasing availability to public school systems, it may be expected that steps toward fuller utilization of television as a medium of in-service education will continue to be made as supervisors and administrators gain more and more confidence and facility in its use. These implications are challenging for educators. Consider, for example, that the supervisor now has at his disposal a medium by which he might, through the use of videotape or kinescope, reach the same objective he could reach through many repeated personal visits and consultations with teachers. The university consultant might, likewise, accomplish through carefully prepared videotapes the same end that he could accomplish through dozens of trips into the field. A curriculum director, furthermore, might through exploiting the many advantages of television, succeed in differentiating his in-service program for teachers of varying needs. Teachers could view special purpose or general information programs in their own school buildings without driving long distances to central meetings places as they commonly do at the present time.

Implications for Research

Teachers. The various media of in-service education used in the present study were accompanied by two additional factors which were common to all four experimental groups. Written materials were furnished to all teachers, and all teachers participated in a testing program. Further research is needed to determine the effect of these two factors upon teacher change in achievement and in classroom practices. Would written materials and a testing program, for instance, be as effective as television or face-to-face lecture-discussion series and a testing program in bringing about hypothesized outcomes? Is in-service education by television without testing likely to be as effective in bringing about specific changes as when testing is included? What anxieties are produced as a result of the testing program and to what extent are the outcomes of an in-service education program restricted by the nature of the test instruments?

Additional research is needed to determine the relative effectiveness of in-service education series similar to those utilized in the present study in increasing teacher understanding in areas other than arithmetic. Would similar results be obtained if the content of the in-service program were directed to objectives in the area of social studies, language arts, science, or the fine arts?

Would a television in-service education program of the nature of that utilized in the present study produce the same results in a school system in which the supervisory role is highly centralized as in a system in which the principal is entirely responsible for the in-service education of teachers within his building? Research to investigate the relative effectiveness of various methods of in-service education under varying patterns of supervisor-teacher relationships is needed.

The present study indicated that classroom consultant services utilized in this study were more effective as a supplement to television presentations than to face-to-face lecture-discussion sessions. The investigators believe that further research utilizing the same type of consultant services but designed specifically to evaluate teacher changes in terms of criteria other than achievement test scores might indicate a more consistently effective role for consultant services.

Throughout the study there was a consistent pattern of changes in teachers and pupils which were related to authoritarianism of teachers. Studies are needed which will help clarify this relationship and assist in identifying ways of working with teachers which takes into consideration individual differences among them. It would seem that a study designed to extend our understanding of authoritarianism as it is related to effectiveness of in-service education programs would provide a fruitful area of investigation.

Pupils. Further research related to and growing out of the present study is needed to enhance our understanding of teacher in-service education and its effect upon pupils.

One of the greatest needs is for the evaluation of the relative effectiveness of other methods of in-service education. To what extent do workshops, child study programs, action research projects, "C" days, teacher inter-visitation schedules, the use of various kinds of written materials only, and team teaching as methods of in-service education bring about change in pupils?

In combining several of these in-service education methods, what is the optimum relationship among them? In this study, there was some evidence that teachers viewing the television series utilized more consultant services than did the teachers attending the face-to-face lecture-discussion sessions. Research is needed to evaluate the extent and kinds of consultant services which might be efficiently utilized by teachers participating in various types of in-service education programs.

Organization of in-service education. Are there differences in the effectiveness of different in-service methods when various leadership roles in in-service education are utilized? What is the relative effectiveness of in-service education when the program is principal directed, teacher organized, or designed exclusively by the central administrative office? Is a volunteer teacher in-service education program more effective than a compulsory program in bringing about changes in pupils? Are in-service education programs which are concentrated into a short period of time more effective than those which are extended over a longer period of time?

Effectiveness in various school settings. There is a need to replicate the present study as well as those suggested above in various school settings. Are there differences in the effectiveness of various in-service methods when the school is organized on a self-contained classroom basis and when the departmentalized or platoon organizational plan is utilized? Further, are there differences in the effectiveness of these methods in promoting pupil change in subject areas other than mathematics, in schools with a variety of in-service opportunities, in schools with a single in-service program, in small communities, in rural areas, and in different parts of the country?

Retention. To what extent do pupils retain concepts developed as a result of a teacher in-service education program? Do these gains continue to grow or decline in subsequent years, and at what rate?

Personal observations of the research team indicated that the effects of the early phases of the in-service education program were more marked near the end of the program than they had been during the weeks immediately following presentation. Is an in-service education program more effective in subsequent years than during the actual time it is presented? Would pupils of the in-service participants in subsequent years benefit more from the in-service education program than those of the year in which it was presented?

Does reinforcement by continued teacher in-service education in a related area increase the rate of change of the pupils of the in-service participant?

In conclusion, it seems that the present study points up a need for the critical examination and evaluation of in-service programs planned to meet needs of *individual* teachers if more efficient in-service education is to contribute to the continued success of the American education effort.

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Appendices

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APPENDIX A

BASIC MATHEMATICS CONCEPTS DEVELOPED IN THE IN-SERVICE EDUCATION SERIES

Section I. Numbers and Numerals

*A. There is a difference between numbers and numerals.
B. Numerals are symbols.
C. Number is a quantitative concept derived from perceptual images.
D. Numerals are used to represent this quantitative concept.
E. Number sense was developed in man historically prior to numerals.

Section II. Base and Place

*A. To communicate quantitative relationships we need not only symbols but also systems of arranging these symbols.
B. The base we use is the one man has selected for use. Any of the several others could have been selected and used with the same effectiveness.
C. In everyday activities we sometimes use other bases. The most frequently used bases other than ten are twelve and sixty.

Section III. Some Properties of Arithmetic

*A. There are some basic properties of arithmetic which govern and simplify our computation.
B. These properties include:
    1. In addition and multiplication interchange of order is permissible (commutativity).
    2. In addition and multiplication grouping is permissible (associativity).
    3. Multiplication distributes with respect to addition.
C. These properties are not universally applicable.

Section IV. The Fundamental Processes: Addition

A. Elementary school children use many kinds of numbers.
B. The definition we use for the addition of one kind of number may be inadequate for another kind of number.
*C. The addition algorithms we use have evolved from more complex arrangements of numerals.

Section V. The Fundamental Processes: Multiplication

A. Multiplication may be defined in terms of repetitive addition or in terms of sets.
*B. Algorithms are devised which conform to appropriate definitions of the process and the laws of arithmetic which are involved.
C. The multiplication algorithm we use today is only one of many algorithms which could be used.
D. Computers which follow the basic pattern of the algorithm have been devised to simplify the labor involved in computation.

Section VI. The Fundamental Processes: Subtraction and Division

*A. Subtraction and division are secondary operations, defined in terms of addition and multiplication.
B. By definitions we expand our number system.
C. Three kinds of problems in the elementary school classroom involve subtraction, and it is frequently said that these give rise to three kinds of subtraction.
D. Two kinds of problems involve division, and it is frequently said that these give rise to two kinds of division.
E. As was true of the two primary operations, many algorithms have been developed to perform subtractions and divisions.

Section VII. Common Fractions

A. Addition and multiplication of common fractions must be defined.
B. The meaning of equality of common fractions plays a central role in both the reduction and division of fractions.
*C. The properties associated with the manipulation of fractions are man-made.
D. There are many ways in which the child experiences the fraction concept.

Section VIII. The Fundamental Operations and Their Relation to the Structure of the Number System

A. The understanding of the structure of our number system enables us to place elementary school mathematics in its larger context.
B. The rational numbers are those with which we usually work in the elementary school.
*C. The number system was developed to keep pace with our need for new kinds of numbers.

Section IX. Decimal Fractions

A. The units place, not the decimal point, is the pivotal position.
B. Estimating decimal position in multiplication and division is important in early decimal work.
C. Decimal notation—past and present—has been represented in a variety of ways.
*D. Differences between common fractions and decimal fractions are differences in notation only.
E. Decimal fractions may be expressed as common fractions. Some common fractions may be expressed as decimal fractions, and all may be approximated by decimal fractions.

Section X. Systems of Numeration

*A. Systems of numeration are man-made.
B. Our numeral system has developed over a long period of time.
C. Some understanding of other systems of numeration will enhance our understanding of our own system.
D. Children can be led to appreciate the utility of the modern decimal system by learning about other systems.

Section XI. Exploding Universe of Mathematics

A. Mathematics is man-made.
*B. Mathematics is dynamic and growing.
C. There are two kinds of mathematics, two kinds of mathematical activity.

Section XII. Creators of Mathematics

A. Men of many chronological ages, historical ages, and stations of life have created mathematics.
*B. History indicates that freedom is essential to creativity in mathematics.

Section XIII. The Development of the Units of Measure

A. Our units of measure were chosen by man.
*B. Units of measure are continually evolving.
C. The evolution of units of measure has been in the direction of the development of standardized units.
D. There is an appreciable difference in the size of units expressed by the same in various countries of the world.

Section XIV. Concepts of Measurement

A. The defined unit of measure is exact; any reproduction of such a unit is an approximation.
*B. Measurements are applications of defined units of measure and are approximate.
C. Both direct and indirect measurements are made.

Section XV. Algebra

*A. Algebra is a generalization of arithmetic.
B. Many of these generalizations take place at the elementary school level.

Section XVI. Geometry

*A. Geometric concepts begin with perceptions of physical realities.
B. Experiences in elementary geometry should involve both inductive and deductive reasoning.

Section XVII. Statistics

A. Inductive reasoning utilizes statistical processes.
*B. Quantitative data may be organized in graphs, tables, etc. for interpretation.

Section XVIII. Mathematics and the Fine Arts

A. The musical tones are related to one another mathematically in terms of vibrations per second.
*B. Perspective is achieved through the use of geometric principles.

Section XIX. Shooting for the Stars

*A. The laws of astronomy are expressed mathematically.
B. Mathematics has enabled astronomers to make discoveries and predictions.
C. In the space age, the astronaut's survival will depend greatly upon his knowledge of mathematics, astronomy, and related sciences, as will the layman's ability to orient himself to his expanding universe.

Section XX. Physics and Chemistry

A. Many of the laws of physics and chemistry are statements about number.
*B. A knowledge of mathematics is an essential requirement for a knowledge of these branches of modern science.

Section XXI. Mathematics and Other Sciences

*A. In recent years the need for quantitative analysis has become increasingly acute in the biological sciences, the earth sciences, and the social sciences.
B. Methods are being devised by which problems in these fields may be formulated mathematically.
C. Mathematical formulation of problems in these fields renders solutions possible by known methods and makes communication more meaningful.

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* The *Test of Mathematics Understanding* and the *Understanding Mathematics Test* were designed to measure an understanding of selected concepts. These concepts are marked with an asterisk(*).

APPENDIX B

Correlation Coefficients between Consultant Variables and Teacher Change, Pupil Change, Selected Teacher Factors, Teacher Personality, and Teacher Reactions to the In-Service Program for Forty-Three Teachers

	Consultant Variables					
	Number of Visits	Total Time in Minutes	Number of Individual Conferences	Number of Small Group Discussions	Number of Classroom Observations	Number of Classroom Demonstrations
Teacher Change						
Understanding Mathematics Test	.27	.50*	—.06	.55*	.08	.15
STEP—Mathematics, Level 2	—.10	—.08	.17	—.10	.07	—.15
Mathematics Teaching Tasks	.12	—.18	.16	—.05	.01	—.18
Pupil Change						
Test of Mathematics Understanding	.23	.27	.21	.11	.38*	.34*
STEP—Mathematics, Level 4	.14	.10	—.10	.18	.11	.14
Mathematics Interest Inventory	—.14	—.05	.12	—.12	.16	—.13
Selected Teacher Factors						
High School Mathematics	.06	—.07	—.04	—.21	—.14	.04
College Mathematics Hours	.04	—.05	—.05	—.09	.16	.15
College Mathematics Methods	.02	—.05	.05	.05	—.09	—.09
Highest Degree	—.05	.14	.15	—.04	.12	.22
Undergraduate Degree	—.27	—.18	—.15	—.25	—.16	—.10
Sex	.47	.04	—.20	.08	—.04	.11
Years Teaching Experience	—.52*	—.14	—.21	—.05	—.05	—.10

Personality						
Christie F	.16	—.01	.07	—.05	—.06	—.12
MTAI	—.01	—.10	.00	.00	—.17	.08
Reaction to In-Service Education Program						
General	—.24	—.39†	.08	—.33*	—.05	—.24
Usefulness	—.16	—.48†	—.14	—.15	—.24	—.30*
Written Materials	.09	.13	—.14	.21	—.16	.07
TV or F-to-F	.04	—.07	—.08	—.02	—.35*	—.08
Frequency	.13	—.25	.05	—.10	—.22	—.13
Extent of Use	.12	—.18	—.12	.02	—.28	—.09
Consultant	.04	—.24	—.02	—.19	—.24	—.12

* Significant at the five per cent point.
† Significant at the one per cent point.

APPENDIX C

TEXAS ELEMENTARY SCHOOL MATHEMATICS CLASSROOM PRACTICES SCHEDULE OF QUESTIONS

* Tell me about your last arithmetic class.
* Where do your arithmetic lessons come from?

TEXT

How many arithmetic textbooks do you use?

1. How do you work through your arithmetic textbook?
   EPg : SkPg : Skpt : SkMst : SkAll
2. Are all of you working in the same place in your textbook?
   AllSm : : 2–3 Grps : : AllDf

WORKBOOK

* Why do you think you use your arithmetic workbook?
How many different kinds of arithmetic workbooks are used in your class?

1. How do you work through your arithmetic workbook?
   : RegAll : IrgSmtAll : TerNd : PplNd
2. How often do you use it?
   : Daily : Weekly : TerNd : PplNd
3. Are all of you working in the same workbook?
   : All : DfntGrps : IndfntGrps : Indiv
4. Are all of you working in the same place?
   : All : DfntGrps : IndfntGrps : Indiv

TRADE

What other kinds of books about arithmetic have you used?
How many?

1. Who chooses these books for you to use?
   : TerTxtSgstd : Ter : Ter-Chld : Chld
2. How have you used them?
   : ReRpts : Terplnsgrp : RptTer-Ppl : IndivInt
   : : IndvrptTer : :
3. How often do you use these books?
   : Over Month : Month : Week : AlmstDly

FREE-TIME ACTIVITY

1. What do you do when you finish your assignments in class?
   : NxtAsgnmt : TerChs : ArithChs : FrChs
2. What kinds of special activities or projects have you done in arithmetic class?
   Text : TerElabText : TeachSgstd : Ter-ChldDrv : Chld

HOMEWORK

1. What kind of homework do you have?
Txt : WkBk : DittoCkBd : AsgnExpPrb : ChldExpPrb

FILMS

* Why do you see films or movies about arithmetic?
How many have you seen this year?

1. What did you do after the film was over?
: Tst : TerSmy : RptDscs : IndvExplr

INTEGRATION

1. In what other subjects do you most often use arithmetic?
None : Isubj : 2Subj : 3Subj : AllSubj
2. Do you also have a regular arithmetic lesson that day?
: Yes : Usually : Not Often : Never

TEACHING AIDS

* What teaching aids and supplies do you think are important in the classroom for learning arithmetic?
Which of these have you used in your classroom?

1. Tell me how you used the ———— to learn a new idea?
: Skills : Abst : Expl : Appl Prep
2. Where did these aids come from?
: Comm : Teacher : Teach-Child : Child
3. How does your class use arithmetic charts and graphs (posters and bulletin boards)?
: Alkls-Abst : Prep : Appl : Expl
: Alks-Abst : Prep : Appl : Expl
4. Where do they come from?
: Comm : Teach : Teach-Child : Child

ORGANIZATION

1. Do you spend the same amount of time studying arithmetic every day?
Yes : FwExcep : SmExcep : FreqExcep : NvrSm
2. Do all of you study the same lesson every day?
No : 2 Grps : 3 Grps : 4 Grps : Indiv
3. Do some pupils have longer or harder assignments in arithmetic?
No : Length : : Level : Lgth&Lvl
4. How do pupils get individual help from the teacher?
Little : Terrexpcls : GrpHp : TerChsIndv : Ppl-Indiv
or None : : : :

DISCUSSION

How much of your arithmetic is spent talking about ideas in arithmetic?

1. Do most pupils take part in the discussion?
Ter : Ter : Ter : Joint : Child

* Do you ever have problems without pencil and paper? That is, mental arithmetic tests?

2. Where do your mental arithmetic problems come from?
   Text : TextEpnd : Terdretd : : Ppl-Ppl

EVALUATION

1. How do you know how well you are getting along in arithmetic?
   RptCrd : Tests-DiagAch : Tertes : TerChlConf : ChlPrgCut
2. Where do your tests come from?
   Txt : WkBk : TerMade : Ter-Child : Child
3. How often do you have tests?
   Dly : Wky : 6 wks : Tpk : Slf
4. Who usually grades your papers?
   Ter : : OthrPpl-Ter : : Slf
5. Where are your grades usually written or kept?
   Ter : : : Joint : Ppl

* Tell me about your favorite day in arithmetic this year.

INTERPRETATION OF CODING THE TEXAS ELEMENTARY SCHOOL MATHEMATICS CLASSROOM PRACTICES SCHEDULE OF QUESTIONS

A. TEXT

(Number)—If use out of adopting text or other text to supplement, indicate total number of kinds.

1. *Use*
   - *(1) Every page—if progress through text from front to back (with the exception of practice sets) and for all practical purposes cover every page
   - (2) Skip page—if a few pages are skipped frequently—at the first of year skipped but not now
   - (3) Skip part—if skip is from part of part, or parts omitted; not (1) or (2)
   - (4) Skip most—if the text is used primarily as a reference or only as a source of practice problems
   - (5) Skip all—if a textbook is not used at all or rarely if ever
2. *Assignment*
   - (1) All the same—if everyone in the class has the same assignment in the textbook
   - (2) Only one or two persons have different assignment or textbook
   - (3) 2–3 groups—have different assignments or work at different places in the textbook
   - (4)
   - (5) All different—for all practical purposes assignments are made on an individual basis

B. WORKBOOK

(Number)—Count tear sheets, ditto practice sheets as workbook type materials

1. *Use*
   - (1) None

(2) Regular assignment for all—work daily, no differentiation in assignments
(3) Irregular assignment sometimes for all
    * Irregular assignments for all
    * Same but permitted to work at own rate
    * One person has a different assignment
(4) Teach ident.—with groups or individual assignments
(5) Pupil selects needed material

2. *Frequency*
(1) None
(2) Daily
(3) Weekly—used regularly once a week, or seemingly without need—as "to keep us busy while he has other work to do." Also for extra credit.
(4) Teacher identifies need of individual or group—when the teacher sees the need for practice, etc. and assigns to either the class, group, or individual as the case may be
(5) Pupil selects needed material—the pupil selects which material he will work on in the workbook

3. *Same workbook*
(1) None
(2) All—all workbooks and materials are the same for all members of the class
(3) Definite groups—one group uses different materials than the other; one or two students may have a different workbook or related materials
(4) Same place—
    (1) None
    (2) All—all the class is working in the same place in the workbook
    (3) Definite groups—where one group is in a different place in the workbook than the other group/s. Or one or two students may be working in a different place than the remaining group
    (4) Indefinite groups—the groups change from time to time; groups have different assignments. Also if the class has no common assignment, but individually permitted to work at own rate
    (5) Individual—for all practical purposes, assignments are made on an individual basis

C. TRADE

(Number)—includes library books, pamphlets, books in the teachers personal library, trade books brought from home, encyclopedias used, etc.

1. *Choice*
(1) None
(2) Teacher chooses text suggested—includes books ordered from textbook company (adopted text)
(3) Teacher—she chooses the books herself, either from the library or other sources. If teacher has child check out specific book from library

(4) Teacher-child—teacher selects the books and the children select from her selection; teacher selects some and children select some from library, home, etc.
(5) Child—the child selects the books to be used, and may bring them to the classroom

2. *Use*
(1) None
(2) Regular reports, drill, tests—if they are required to report at regular intervals on reading; if the books are a source of drill or practice materials; if a test is the only follow-up on the reading of the books. If teacher uses books and children mention that she lectures on materials
(3) Teacher plans group's or individual's report—assigned report
(4) Report as a result of teacher-pupil planning—allows for pupil choice in topic, but the teacher has a hand in planning, assigning, or suggesting. Also includes extra-credit reports
(5) Report as interest to individual—may report if he wants to, strictly voluntary—however, usually evidence needed that someone has or evidence that there is ample opportunity to read and not report if he chooses to

3. *Frequency*
(1) None
(2) Over month—once or twice in a six months period
(3) Month—average of once a month
(4) Week—not every week yet more often than monthly
(5) Daily—evidence that some pupils use the books daily and that there is opportunity for many students to use them

D. FREETIME ACTIVITY

1. *Finish text-workbook assignment*
(1) Don't finish
(2) Next Assignment—when they say they go on to homework, etc.
(3) Teacher choice—teacher either tells them what to do or "to sit and be quiet until the others finish."
(4) Arithmetic choice—students can do anything in arithmetic such as go to the arithmetic table, read trade books, etc.—students choice
(5) Free choice—students choose to do anything

2. *Special arithmetic activities*—
(1. List all. 2. Record total number of special activities. 3. Record number of project related activities.)
(1) None
(2) Teacher elaboration on text—teacher takes a topic from the text and initiates some activity suggested there—such as making a chart, graph, etc.

(3) Teacher suggested—or assigns something outside of the text, discusses a topic outside of the text, initiates an activity not in the text (or related materials)

(4) Teacher-child developed—teacher makes broad assignment or gives broad suggestion and the children have the freedom to choose and develop an activity themselves.

(5) Child on his own—child has freedom to choose what he does and how to develop it; evidence that he has originated and developed the activity brought to class

E. HOMEWORK

1. *Source*

(1) Text—almost solely the text

(2) Workbook—about half from the workbook and half from the textbook some ditto, some text and/or workbook

(3) Ditto-Chalkboard

* Not from textbook
* Sometimes experiential problem and sometimes text or workbook
* Make up problems similar to textbook problems

(4) Assigns experiential problem—source outside of text where child has to find facts as well as to work the problem

(5) Child brings experiential problem—brings something from his own experience to class; brings a "real" problem to class—voluntary on the part of the student

F. FILMS

(Number)—includes filmstrips, slides, etc.

1. *Follow-through*

(1) None

(2) Test—only follow through

(3) Teacher summary—teacher asks questions and students answer or teacher simply summarizes

(4) Report or discussion—children report on film; discussion must be a 50–50 one where pupils take an active part—not merely a teacher questions-child answers session

(5) Individual exploration—where the children try some of the things shown in the film or do some additional activity or reading

G. INTEGRATION—*Omit*—Not applicable to Dallas because of platoon organization

H. TEACHING AIDS—list all mentioned, tabulate total number of manipulative and graphic aids.

(Number)—charts, etc. (felt board) manipulative, etc.

1. *Use*

(1) None

(2) Skills—games, etc. for drill or practice (little use, or teacher used)

(3) Abstraction—when aid is used concurrently with pencil and paper, etc., when we get mixed up

(4) Exploration—use of teaching aid before they work problems—children actually use it
(5) Application, preparation—preparation: used in introducing a topic; application: after abstraction to relate the abstract back to the concrete

2. *Source*
(1) None
(2) Commercial
(3) Teacher—either the teacher makes or some source other than the students in this particular class
(4) Teacher-child—half and half
(5) Child—children make practically all

3. *Charts, use of*
(1) None
(2) Skills, abstraction—to develop skill through practice or use—of a concept already learned
(3) Preparation—to prepare students for the new concept—stimulate interest
(4) Application—where the children (or teacher) makes a chart to show application of concept learned
(5) Exploration—actually explore when making the chart; or use a chart to explore—for example, *making* a Base 5 chart.

I. ORGANIZATION

1. *Equal time daily*—not applicable to Dallas

2. *Grouping*
(1) None
(2) 2 groups—two major groups or if only one or two persons have a different assignment
(3) 3 groups
(4) 4 plus groups
(5) Individual

J. DISCUSSION—Record per cent of class period spent in discussion

1. *Who talks*
(1) (Teacher)—virtually does *all* the talking
(2) (Teacher)—children talk a little—teacher asks some questions
(3) (Teacher)—teacher questions, children answer
(4) (Joint)—both contributing equally and asking questions

2. *Mental arithmetic*
(Topics from text)—if not *true* mental arithmetic or text used only for mental arithmetic problems
(Text expanded)—text plus teachers personal books or plus some made up and estimation
(Teacher directed)—she makes most of them up or some source other than the text, workbook or teachers manual
(Pupil and teacher directed)—pupils bring some and teacher brings some
(Pupil-pupil)—where pupils take initiative and administer them

K. EVALUATION

1. *Progress*
    - (1) Report card only
    - (2) Tests (diagnostic or achievement tests)—teacher sends tests or notes home to parents
    - (3) Teacher tells—The child—or daily papers she keeps—progress chart up for everyone. Include notebook or folder if just keep it, and no evidence of real use. Sometimes the class averages their grades, sometimes class keeps some grades and sometimes individuals keep all grades
    - (4) Teacher-child conference—talks with child privately
    - (5) Child's own progress chart—child keeps a record of his own grades, texts or otherwise
      Notebook or folder if evidence that it is really used to keep up with individual progress
2. *Evaluation devices*
    - (1) Test—if directly, or from teacher manual
    - (2) Workbook—if sometimes text, sometimes made up, sometimes other tests
    - (3) Teacher-made—primarily made up by teacher
    - (4) Teacher-child
    - (5) Child
3. *Frequency*
    - (1) Daily
    - (2) Weekly—set day
    - (3) 6-weeks
    - (4) Topic
    - (5) As needed
4. *Grading and checking*
    - (1) Teacher—all
    - (2) Teacher and helper
    - (3) Other pupil and teacher
    - (4) Self and teacher
    - (5) Self
5. *Recording*
    - (1) Teacher
    - (2) Occasionally otherwise
    - (3) Folder or notebook
    - (4) Joint-group and teacher
    - (5) Self

* Numerals in parentheses:
(1) "Text" col. TESMCPIS
(2) "Text-Teacher" TESMCPIS
(3) "Teacher" TESMCPIS
(4) "Teacher-Child" TESMCPIS
(5) "Child" TESMCPIS

TEXAS ELEMENTARY SCHOOL MATHEMATICS CLASSROOM PRACTICES INTERVIEW SCALE

TOPIC	SUBJECT OF QUESTION	TEXT	TEXT - TEACHER	TEACHER	TEACHER - CHILD	CHILD
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]